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BRIEFLY TOLD.

ELECTROLYSIS.—At the last meeting (July, 1898), of the Pacific Coast Gas Association a paper, on "Some Possibilities with an Electric Lighting Plant," was read by Mr. C. O. Poole, of San Francisco. Mr. Poole put forth a reasonable argument over such possibilities, and did not claim more for the electric current producing station than its force afforded; but Mr. Poole's paper accomplished that which likely he did not anticipate, which extra revealment came out in the discussion that followed his presentation. One of the participants in the debate was Mr. W. A. Aldrich, Secretary of the Spokane Falls (Wash.) Gas Light Company, who called attention to the fact that central electric stations included in their possibilities, especially when a portion of the work of such stations was devoted to traction purposes, the function of doing harm to the pipes that led gas and water to the users of either from central stations of other natures. Supporting his contention by a practical citation, he stated that the mains of the Spokane Falls Gas Light Company had been so badly damaged by stray currents from the street railroad system operated by the Washington Water Power Company's electrical currents that his Company, in self-defence, and on account of desire for repayment because of damage done, had instituted suit against the Power Company. That suit has been heard, so far as the presentation of evidence is concerned, and the argument on the evidence is quite likely now, too, before the court, whose decision may be looked for at any time. Meanwhile, however, the matter that presses is whether it is worth while that the gas industry at large shall support Mr. Aldrich in the proposition that he cause to be printed in book or pamphlet form the evidence taken during the active trial of the case. Suitable publication of the story, which was comprehensive and exhaustive, means quite an expenditure, but Mr. Aldrich is willing to undertake the task, if, say, 100 subscriptions are made to the proposed book, at the rate of $3 per subscription. For our part we will subscribe for 10 copies of the evidence, at the price named. Those who believe that the electrolysis experience of the Spokane Falls Gas Light Company is worth the having—and we are sure that it is—as told by that Company's representatives in court, should put themselves at once in communication with Mr. W. A. Aldrich, Secretary of the Spokane Falls Gas Light Company, Spokane, Wash.

NOTES.—Write to the "Nathaniel Tufts Meter Company," Boston, Mass., for a copy of the Company's "Directions for Candle Power Determination; Ammonia, and Meter Testing." It will be found handy, instructive and useful, in even the smallest gas works. It is written in the simplest and best style, from compilations furnished by Mr. Charles D. Jenkins, State Inspector of gas and gas meters for the State of Massachusetts.——We regret to report the death of Mr. D. G. A. Davenport, who served the Cincinnati (Ohio) Gas Light and Coke Company well as Treasurer for quite over 15 years. Deceased was born in Cincinnati in 1823, and in the city of his birth (strictly speaking at the time of his birth Cincinnati was a straggling village) his useful, active career was passed. Graduating from the Woodward High School, the son started in active business life as a school teacher—the profession that his father had followed. In 1857 he became identified with the Little Miami Railroad, and was closely connected therewith, until 1882,

when he was elected Secretary of the Cincinnati Gas Light and Coke Company. In that important trust he remained until 1897, when failing health obliged him to relinquish active participation in commercial life—his successor in the Treasureship (who had been of great aid to him in the duties of the office for years) is Mr. Charles J. Foust. Mr. Davenport was prominent in the affairs of the Baptist sect, and had been active in the direction of the Ninth street Baptist Church, Cincinnati, for one half a century. He is survived by his widow and nine children.——Another death that will appeal to the minds of the fraternity is that of the Hon. P. P. Mast, who passed over at his home in Springfield, Ohio, the afternoon of November 20th. Deceased, who was in his 75th year, began life as a school teacher, subsequently engaging in the manufacture of agricultural implements, the firm name of the concern—P. P. Mast & Co.—being world famous. Another Company with which he was connected—Mast, Foos & Co., manufacturers of windmills—is also of international reputation. His main connection with the gas business was in his ownership or control of the Citizens Gas Light and Heating Company, of Bloomington, Ills., of which corporation he was President for many years. He served Springfield as a Councilman for 22 terms, and was Mayor of that city from 1894 to 1896. He was prominent in Methodism in Ohio, and many whose start in life was made through his aid live to acknowledge his unostentatious benevolence.——Important changes have occurred in the proprietorship of the Muskegon City (Mich.) Gas Light Company, which changes seem to indicate that the gas and electric lighting interests of the place have at last been harmonized. Had the electric lighting proprietors been possessed (at the start) of less theoretical brilliancy and more common sense their present standing would be financially better than it is.——We understand that Mr. William H. Pearson, Jr., of Toronto, Canada, has been retained by the authorities of Buffalo, N.Y., to formulate a set of working plans for the proposed municipal gas works for Buffalo. Meanwhile the site for the said proposed works has not been selected.——The proprietors of the Winsted (Conn.) Gas Company are showing some signs of life, for a correspondent informs us that they "are going to erect a new office building in Case avenue." Perhaps in time they will put their gas works in better shape.——A correspondent forwards the following, from Oswego, N.Y.: At a special meeting of the Board of Directors of the Oswego Gas Light Company, held Saturday, November 26th, the following resolutions were adopted:

"*Whereas*, Divine Providence has removed from our midst our esteemed friend and associate, Henry S. Wright; and

"*Whereas*, As members of this Board, we, owing to our greater acquaintance and close contact with the deceased, feel deeply the loss we have sustained; therefore, be it

"*Resolved*, That in the death of Henry S. Wright, this Board has lost one of its worthy members, whose modesty and uniformly courteous bearing rendered his service most acceptable. We know that we shall greatly miss his pleasant and cordial fellowship.

"*Resolved*, That we extend our sympathy to the sorrowing family, and that, as a lasting and impressive remembrance of our friend, these resolutions be inscribed in the minutes of the Board, and a copy be sent to the members of his family.

"JAS. DOWDLE, Pres.
"ROBT. G. POST, Secy."

The Extinction of Wrought Iron.

Iron Age declares that, with the resistless force of a glacier, but with a rapidity which is only slightly appreciated, steel is now supplanting all forms of wrought iron. Forcible arguments in favor of iron for certain purposes may be made, numerous engineers may continue to specify iron for special classes of work to which they consider it is better fitted than steel, and prejudice may incline the masses of iron workers to prefer the material which can be welded with least trouble, but the day is near at hand when wrought iron will be an exceedingly scarce commodity. Arguments, preferences and prejudices are equally powerless to stop the advance of the metal which can so much more easily be produced in large quantities than wrought iron.

Complaints continue to be heard among mechanics of hard spots in steel which make it of an uncertain character in working, as for instance, in threading pipe; of its occasional unsatisfactory behavior in holding a coat of other metal, as in the case of galvanized steel sheets, and of its comparatively rapid oxidation when exposed to the weather or to the action of water. For such reasons a reaction of more or less strength is from time to time noted in favor of wrought iron, but the greater cost of puddled iron as compared with steel silences the complaints, the steel maker sedulously endeavors to turn out a more reliable product and steel continues to preserve its ascendency.

The end of this century, which is now near at hand, will in the estimation of even those who are deeply interested in wrought iron see the end of wrought iron as a distinctive designation, except, perhaps, in the case of Swedish iron or some other high priced iron specialty.

Sudden Extinctions of Artificial Light.

[By MR. NORTON H. HUMPHRYS, F.C.S., in the *Journal of Gas Lighting*.]

The extent to which the public business and pleasure are dependent upon the supply of artificial illuminating agents from central stations, is never more apparent than when, by reason of accident or otherwise, a sudden and unlooked-for stoppage or failure occurs, and the brilliantly lighted places of business or of amusement are instantly in darkness. In the ordinary household, the inconvenience is bad enough, though substitutes are usually not far off. In shops or places of assembly, however, there is not only the temporary annoyance, but also a very real element of loss and personal danger to be reckoned with. It, therefore, behoves all who are in any way responsible for the distribution of lighting agents, to resort to every possible device that science or skill can suggest as a means of insuring continuity and regularity of supply. As regards electricity, failures are so frequent that the public have come generally to understand that they must not expect too much in the way of reliability from this mysterious form of energy; and an occasional extinction is taken in good humor, as a matter of course, and excites but little comment. But with gas the case is different. The fact that gas is used more generally and to a greater extent, not for lighting alone but also for many other purposes, and that therefore the effects of a sudden extinction are more widely felt, may have some influence; but the public have learnt to expect a greater degree of reliability from gas than from electricity. Any failure in respect to gas supply attracts much more attention, is more fully discussed in the papers, and is regarded as a more important thing, than half-a-dozen similar accidents with the electric current. Only within the last few weeks, a failure of the gas supply at a well-known seaside resort was considered sufficiently important to receive prominent positions in the London daily papers. If electricity had been the delinquent, a bottom paragraph on an inside page would have been the limit of the attention bestowed on it. The fact of a gas failure being such an extraordinary occurrence as to excite so much notice, is a compliment to the reliability of gas supply in general.

That failures teach more than successes, is a common aphorism; but for several reasons it is difficult to get to the real bottom of all the facts connected with a failure. Few delinquents have the necessary moral courage, or if they have, it frequently happens that they cannot afford to come forward and pose before their employers and the public in the position of the "dreadful example" we sometimes hear of in connection with temperance platforms. Anyone with an average knowledge of the ways of the world is aware that a blunder is generally regarded (and requited) as being worse than a crime, and also that there is a general disposition to make a scapegoat of some one or other; and therefore a willingness to come forward and publish the whole of the details for the benefit of the profession at large is not to be expected. But, speaking broadly, there is a noticeable difference in the causes that lead to failure of gas supply, as compared with those concerned in the stoppage of the electric current. The arrangements for the distribution of gas are of an extremely simple character. They commence with the holder itself, and are quite independent of the manufacturing or the purifying apparatus. The gasholder outlet is controlled by a valve, and beyond the valve there is an automatic pressure regulating apparatus. All the mechanical parts involved are plain levers, pulleys, racks, etc., that are not at all likely to get out of order, or to spontaneously stop the supply of gas. But there is always more than one gasholder; and for various reasons the supply must be diverted from one to another perhaps once or twice every day. The drip boxes also require to be emptied regularly, which is a very simple operation indeed, involving no risk of danger or stoppage. But the human agent is liable to occasional lapses or momentary oversights; and these are the cause of the majority of gas supply failures. One valve is shut off before another is turned on, or the holder is forgotten and allowed to run on ground. The known instances of the failure of gas supply that are due to really unavoidable causes—such as the sudden collapse of a gasholder, valve, or governor—are so few that they could be counted on the fingers of one hand. The arrangements for the supply of electric current are diametrically opposite in character. The generating apparatus is usually a part and parcel of the distributing system, which comprises machinery of such a complicated and delicate character as to call for high appreciation. While the gas engineer relies upon his valvesman to take care of the varying circumstances of the supply, the electrician depends upon his automatic cut off and other mechanical devices. When a gas explosion occurs, there is usually the satisfaction—such as it is—of ascribing the accident to somebody's recklessness or

ignorance, and the same is the case with the failure of the gas supply. With electricity, however, both accidents and failures are of a more unavoidable nature.

One peculiar feature in connection with sudden extinction may be noticed in passing. Sunday evenings appear to be the most unfortunate period. This is probably due to the special arrangements that are necessary, in order to enable Sabbath rest to be observed at the works to the utmost extent that is possible. But, according to popular report, it happens that hymns and texts appropriate to the unexpected event about to take place have been previously selected. Many preachers go further than this, and adopt the remark they are making at the moment to some sort of harmony with the event. The number of instances of this remarkable circumstance go far beyond the bounds of mere coincidence, and appear to suggest the desirability, in the event of an officiating minister finding that references to "light" are prominent in the various details of the coming service, of sending an advance notice to the gas works, so that extra care against mishap may be observed. These premonitions do not invariably come true. A few weeks ago it happened that the writer having fitted up a large church with new Welsbach burners while under repair, attended the reopening service, and references to "light" were made very frequently throughout the proceedings. The new burners, however, kept steadily at work, without even a kick. Probably the real explanation is to be found in the extraordinarily large demand on the part of the public for news items of an extravagantly incredible kind, and also in the fact that the subject of "light" is so very suitable for illustrative purposes in connection with religious subjects that almost every service held would furnish ample matter of this description for the ingenious and imaginative reporter.

In regard to about a dozen instances of failure of gas supply, sufficient to plunge an important part of the district in darkness, the circumstances of which have come to the personal knowledge of the writer, the majority were the result, not of culpable negligence, but of inadvertence. It is easier to make "cock sure," than to apply a test or examination; but at the same time this common practice is not an indictable offence. The faulty siphon pump, referred to by Mr. Douglas Hall, has been responsible for one failure, and the excellent plan of sounding the drips, as advocated by this gentleman, should be adopted. Pumps are apt to fail for more reasons than one; or the man who uses them daily may, in the course of time, get into slipshod ways. There is the siphon that "never has anything in it," and is therefore left alone, or is tested in an absent and perfunctory manner, and all goes well for years together. But one day the unexpected happens, and the siphon is found to be full of liquid. I prefer to go a step further, and not only gauge the drip boxes, but also book the results. It is not much trouble, and the records have at times proved extremely useful, while the mere fact of having to enter the result, and knowing that the entry will be examined, renders the operator more careful. If the drip does not fill at the normal rate, or fills more rapidly than usual, there is something going wrong that should be discovered and promptly remedied.

As to gasholder outlet valves, a plan similar to the "staff system" used in working single railway lines for traffic in each direction, may be adopted, The "staff" in this case may consist of a small notice board bearing some such inscription as—"This label must always be on an open outlet valve;" and a standing order is made to the effect that it is not to be touched except for the purpose of moving it to another open outlet valve. Compound valves of the dry-faced type, so constructed that it is impossible to shut off the supply—one holder coming on while the other is passing off—are serviceable and reliable. A bye pass direct from the main inlet to the main outlet is useful at times of specially large demand, and for temporary employment when the outlet valves are under repair. This bye-pass may with great advantage be fitted with a safety bye pass governor, adjusted to come into action at one or two-tenths below the pressure given by the highest holder. Two or three holders of adequate capacity are preferable to a battery of smaller ones; but where the latter have to be worked, the inconvenience and risk may be modified by coupling up two or more together, either by loading the lighter one till the pressure of each is equal or by fixing stops on the upper end of the guides of the lighter holder, so adjusted as to prevent it from blowing. The two can then be worked as one holder, of a capacity equal to their combined content. These plans are particularly suitable for small country works, where no special valve man is employed. I remember that the chairman of a small village gas company called on me some years ago, and said that the gas from his works was in the habit of "going out" suddenly in the evenings, perhaps once every three months. As he observed that this was not the usual experience, he thought there must be a remedy. Inquiry elicited the fact that two small gasholders, and a working manager who liked his drop of beer in the evening, were concerned in the difficulty. As one of the holders alone was unequal to the evening's requirements, the other had to be brought into use about 9 o'clock; and it was in connection with this simple operation that a slip occasionally happened. Coupling up the holders, and thus avoiding the necessity for changing or any interference with the valves in the hours of darkness, proved a complete remedy.

Of the few failures due to unavoidable causes, one is worth relating in detail. The drum of the station meter had got out of truth, on account of the wearing of the journals; allowing the axle to bear, and to grind upon the spout. This went on until the metal was rubbed nearly through at that particular place. During the small hours of one morning, a large portion gave way, allowing a sudden rush of water down the inlet. The meter valve, the main outlet and the main inlet all drained into one common drip box; and by this means the water reached the main outlet, rushed down the outlet of the holder in use—which happened to be the only one on a lower level—sealed the siphon and stopped the gas. I have described this as a failure; but, as a matter of fact, it was not the cause of the slightest inconvenience in the district, as a safety bye-pass governor formed a part of the distributing plant. When the foreman came on duty at 6 A.M., he found the safety governor in full operation and the other governors grounded; and the pressure diagrams showed that this took place about 4.30. The only evidence was a diminution of the supply pressure from the usual 16-10ths to 14 10ths. No complaint was received from the district, and nothing at all was known of the accident outside the gas works.

The foregoing are a few examples of what may be done in the way of guarding against inadvertence or oversight on the part of the foreman in charge; and the safety bye-pass governor will take care of failures due to mechanical causes.

Localizing Leakages.

[A paper read by MR. W. B. RANDALL (Waltham Abbey, England), before the Southern District Association of Gas Engineers and Managers.]

The subject of localizing leakages will occur to most gas engineers in the routine of business, being closely allied to that "will o'th' wisp," unaccounted-for gas, which so largely determines the success of gas undertakings. Dividends are truly said to be made or lost in the retort house; but, according to the annual Parliamentary Returns, it must be conceded that in many cases good manufacturing results are marred by a weak distribution system, and the dividend thereby lessened.

I do not propose to quote statistics on the amount of leakage, as they are already well known, but simply to submit a method of localizing leakages which I have found to be both economical and satisfactory. The usual plan pursued in testing distributing mains, services, etc., is to take a length of main, drill holes, and insert bladders at both ends; then connect up with a testing meter, and note the amount passing through the meter to supply the main under observation. One bladder at each end is not reliable, as they are apt to pass a certain amount of gas and so spoil the value of the test. The safer method is to have two bladders close together, filing the space between them with water from a short standpipe, or to cut out and plug off the main at each end, having first shut off all main, lantern cocks, etc., on the particular length under observation. Another method is to have siphons which, by means of a diaphragm or midfeather reaching within with a few inches of the bottom of the box, can be sealed by water, and so insure gas only passing through the arranged connections and meter.

The principal objection to these methods is that they are liable to cause a certain amount of inconvenience to consumers, through having to shut off their main tap during the tests. Also that in bladdering and meter connections considerable time and labor are expended, and the main weakened by the necessary holes. Again, the main taps and lantern cocks may by-pass or leak; and after ascertaining the exact amount of leakage, the actual source remains to be discovered.

The Localizer.—These objections do not exist in the following system, which depends upon using a leakage indicator. This consists of a porous diaphragm, through which any mixture of gas and air can percolate, and which is so arranged that the percentage volumes are indicated by a pointer on a graduated dial. The instrument operates through the well known law of diffusion of gases—viz., the velocity of diffusion of gases is inversely proportional to the square roots of their densities. Thus four volumes of hydrogen will pass through the

Localizing Leakage.

Year and Quarter.	Half Year.	Year.	Gas Made.	Gas Sold.	Used on Works.	Leakage.		Gas Made Per Ton.	Gas Sold Per Ton.	Miles of Main	Number of Consumers.
1892.			Cubic Feet.	Cubic Feet.		Cub. Ft.	Per Ct.	Cub. Ft.	Cub. Ft.		
Michaelmas ...	...	...	4,498,800	3,253,500	...	1,245,300	27·03	10,684	7,727	...	...
Christmas ...	...	...	8,846,400	7,890,900	...	955,500	10·79	10,645	,495	...	...
	Dec. 31	...	13,345,200	11,144,400	...	2,200,800	16·48	10,671	8,901	15	500 (250 P.L.)
1893.											
Lady-day ...	...	...	7,714,500	6,910,100	...	804,400	10·42	10,570	9,469	...	...
Midsummer ...	...	...	4,319,800	3,469,700	...	850,100	19·67	10,664	,567	...	...
	June 30	...	12,034,300	10,379,800	...	1,654,500	13·75	11,094	9,569	...	...
Michaelmas ...	...	...	4,805,800	3,789,900	47,000	968,900	20·01	10,562	8,329	...	...
Christmas ...	...	...	9,022,500	8,348,000	93,000	581,500	6·44	10,334	9,562	...	...
	Dec. 31	...	13,828,300	12,137,900	140,000	1,550,400	11·20	10,414	9,140	...	...
		Dec. 31	25,862,600	22,517,700	140,000	3,204,900	12·38	10,718	9,332	15	539 (247 P.L.)
1894.											
Lady-day ...	...	...	7,934,700	7,170,100	86,000	678,600	8·54	10,254	9,263	...	...
Midsummer ...	...	...	4,849 200	3,778,900	42,000	1,028,300	21·20	10,252	7,989	...	...
	June 30	...	12,783,900	10,949,000	128,000	1,706,900	13·36	10,662	9,131	...	...
Michaelmas ...	..	...	5,796,000	4,907,800	52,000	836,200	14·42	10,465	8,861	...	...
Christmas ...	...	...	9,992,300	9,285,400	106,000	600,900	6·01	10,527	9,782	...	...
	Dec. 31	...	15,788,300	14,193,200	158,000	1,437,100	9·11	10,504	9,443	...	...
		Dec. 31	28,572,200	25,142,200	286,000	3,144,000	11·00	10,574	9,305	18	762 (271 P.L.)
1895.											
Lady-day ...	...	...	9,144 000	8,369,700	97,000	677,300	7·40	10,228	9,362	...	...
Midsummer ...	...	...	5,374,500	4,423,800	48,000	902,700	16·80	10,527	8,589	...	...
	June 30	...	14,518,500	12,793,500	145,000	1,580,000	10·88	10,924	9,735	...	...
Michaelmas ...	...	...	6,036,000	4,977,700	111,000	947,000	15·68	11,095	9,187	...	...
Christmas ...	...	...	10,656,000	10,210,500	223,000	223,000	2·09	10,602	10,258	...	...
	Dec. 31	...	16,692,000	15,188,200	334,000	1,170,000	6·41	10,774	9,869	...	...
		Dec. 31	31,210,500	27,981,700	479,000	2,750,000	8·81	10,840	9,719	21	880 (293 P.L.)
1896.											
Lady-day ...	...	...	8,998,000	8,800,900	97,000	100,100	1·11	10,561	10,388	...	...
Midsummer ...	...	...	5,539,000	4,829,200	48,000	661,800	11·95	10,431	9,094	...	...
	June 30	...	14,537,000	13,630,100	145 000	761,900	5·25	10,511	9,855	...	...
Michaelmas ...	...	...	5,994,000	5,577,700	83,000	333,300	5·55	10,608	9,872	...	...
Christmas ...	...	...	11,028,000	10,399,300	167,000	461,700	4·19	10,335	9,746	...	...
	Dec. 31	...	17,022,000	15,977,000	250,000	795,000	4·67	10,430	9,790	...	...
		Dec. 31	31,559,000	29,607,100	395,000	1,556,900	4·93	10,467	9,820	23	865 (299 P.L.)
1897.											
Lady-day ...	...	...	10,253,000	9,565,600	200,000	487,400	4·75	10,486	9,783	...	...
Midsummer ...	...	...	6,201,000	5,636,500	100,000	464,600	7·49	11,152	10,137	...	...
	June 30	...	16,454,000	15,202,100	300,000	952,000	5·79	10.726	9,910	...	...
Michaelmas ...	...	...	7,141,000	6,531,800	133,000	476,200	6·66	11,037	10,095	...	...
Christmas ...	...	...	12,949,000	11,387,500	267,000	1,020,500	7·87	10,701	9,411	...	...
	Dec. 31	...	20,090,000	17,919,300	400,000	1,496,700	7·46	10,819	9 649	...	...
		Dec. 31	36,544,000	33,121,400	700,000	2,448,700	6·69	10,776	9 767	25	910 (311 P.L.)
				In store +	274,000						
1898.											
+ In store, Dec.	31, 1897	...	274,000								
Lady-day ...	...	...	10,861,000	10,256,700	200,000	600,300	5·39	10,807	10,283	...	...
			11,135,000	In store +	78,000						
+ In store, Mar.	31, 1898	...	78,000								
Midsummer ...	...	...	6,381,000	6,113,200	100,000	182,800	2·83	10,706	10,256	...	...
			6,459,000	In store +	63,000						
	June 30	...	17,242,000	16,369,900	300,000	783,100	4·46	10,769	10,225	25	940 (312 P.L.)
+ In store, Dec.	31, 1897	...	274,000								
			17,516,000	In store +	63,000						

Increase partly explained by inflation of new gasholder and laying 1¼ miles of 12-inch main.

diaphragm in the same time as one volume of oxygen is able to do; oxygen being 16 times as heavy as hydrogen.

In the case of a district where plans, notes, or records are not obtainable as to the size and positions of the gas mains, ordnance maps are procured, and copies of the thoroughfares are transferred on an enlarged scale to a suitably ruled notebook. All new mains when laid are duly noted as to their sizes, position, etc., and a plan and section of the ground showing the main is made as required. The service layers also note the depth and position of the main whenever they excavate to lay or repair a service; and as other opportunities occur—such as excavations to sewers or water pipes—notes are made of same and recorded.

The Procedure.—The method of procedure must, of course, be governed by the locality; but, as an instance, let us presume that we start from the outlet of one of the district governors, and that for 100 yards the main is laid in a straight line under a macadamized road, and has about 2 feet cover. Having ascertained the exact position of the main, a searching rod is driven down on alternate sides of the main at each end. The space between is marked off into distances of about three yards each; then another rod is driven down near the side of the main, so that as nearly as possible the search holes run diagonally, and in the trench originally excavated for the main when laid. It is hardly necessary to add that discretion must be used, so that the rod does not cause damage to any water, sewer, or drain pipes, or the gas main itself. Having driven a rod down to about the level of the underside of the main, a little sand is placed round the top of the hole to secure an even surface. The rod is then withdrawn, and the indicator immediately placed over the search hole. If the pointer on the indicator remains at zero, it may safely be assumed that the main within some yards of that spot is sound. The search hole is then filled in, the bar driven down at the next point, and so on; the testing being continued until the pointer moves and indicates a leakage. Then the value of the instrument is apparent, because you can drive down rods and note the readings until the manimum is indicated, when, on excavating at that spot, the actual leakage will be discovered. After a little experience the operator becomes remarkably accurate in successfully localizing the leakage. Where the mains are laid under the footpaths, which may be paved with Victoria stone, granolithic or York stone, the rod is driven down in the angle of the nearest joint. Tar or asphalt paving offers no such chances; but the hole made by the rod is only ¾ inch diameter, so that it is easily and immediately repaired, to avoid any possible complaint.

Efficiency and Cost.—The instrument is extremely sensitive; and the pointer will indicate very minute leakages. As an evidence of this, I may mention that in some cases when the leakage was exposed it was so small that it would not burn continuously; and in other instances, when the conditions admitted, a light was applied on drawing out the bar, and it would not show the small blue flame so often found in main and service leakages.

It is very remarkable how some soils have the power of deodorizing the gas so that in the case of broken mains in frequented places no idea of their condition was entertained until discovered through using the indicator. Also in some instances leakage had occurred to the mains and services through persons having seriously damaged them, and, instead of notifying the fact to the gas company, had driven in rough wooden plugs, and bound up other places with sacking and white lead and various other subterfuges, to cover up the damage. One of these cases was caused by an irresponsible agent—viz., a root of ivy. This had run under a 2-inch cast iron main, moulding itself as it grew to the shape of the pipe, and when it gained sufficient strength causing a fracture in the main. But as punishment should always fit the crime, the escaping gas retaliated and killed the ivy.

The question will naturally arise as to whether the saving effected justifies the outlay incurred; and it may be taken for granted that where the unaccounted-for gas equals about 8 per cent., the expenditure on this or some other system is well warranted. The actual cost of, say, two indicators and six searching rods will not exceed $20; and if the exact position of the mains is known, the actual time in testing is reduced to a minimum, as compared with any plan of metering the leakage and stripping the mains.

Many remarkable instances of difficulties caused through the elusive nature of gas leakages will have occurred to all the members; and I venture to hope that the system which I have had the pleasure to bring before your notice may save some of the trouble and expense in localizing leakages.

The following figures will probably prove interesting as an instance of reduction of leakage; and, in conclusion, please allow me to state that they are not advanced to claim the total reduction being caused directly through the leakage indicators, because we have relaid some mains and services. Neither do I wish to make any claim to have originated this particular system, or to have reached the irreducible minimum as regards leakage. But if I have succeeded in laying before you a method which may prove of some service to the members, and help the gas industry to strengthen a weak point, I shall feel well repaid for the time given to the writing of this paper.

Methods of Testing Indicators.

[A paper read by Prof. D. S. JACOBUS, Hoboken, at the New York Meeting of the Am. Society of Mechanical Engineers.]

The attention of the writer has been drawn to the fact that there should be some uniform method of testing indicators, through tests which he recently made on a pair of indicators in which the variation of the correct scale from that marked on the spring involved a large sum of money made payable by a contract. These indicators had been tested by using a mercury column as a standard, and the results gave a widely different scale for rising and falling pressures; that is, there were double lines obtained in the test diagrams for each pressure, the lower line being for a rising pressure and the upper line for a falling pressure. On testing these indicators with the testing apparatus in use at the Stevens Institute of Technology there were no double lines traced on the diagrams except for one of the higher pressures with one of the indicators, where the two lines were about one-hundredth of an inch apart. The scales of the springs were much more uniform for the various pressures than those obtained by the mercury column, and the difference between the scales obtained by the mercury column and by our method was a large one, and seemed especially so when the amount of premium involved in the contract was considered. In view of the fact that there may be a difference in the results obtained by various laboratories, and also as a standard method, will have to be decided on in the report of the committee appointed to codify and standardize the methods of making engine tests, it may be well to describe our methods in detail, and solicit discussion on the same.

The method we have adopted in testing an indicator is to regulate the pressure to some given amount and to trace two lines with the indicator; one after pressing the pencil upward and releasing it, and the other after pressing it downward and releasing it. Before taking each one of the lines the indicator is rapped sharply with a small wooden stick in order that the friction shall approach the friction of motion which exists when an indicator is used on an engine. If the indicator is in correct adjustment the two lines should fall one over the other.

In testing an indicator with steam pressure, the steam is first brought to the maximum pressure to which the indicator is to be subjected, and the indicator cock is then opened and closed a number of times in order to heat the indicator. The steam pressure is then released, and the atmospheric line is taken after turning the indicator cock to the proper position. Two lines are traced for the atmospheric line in the manner already described, and one should fall over the other in the same way as for the lines taken at given steam pressures.

Ordinarily for pressures above the atmosphere the lines are taken for increments in pressure of either 10 or 20 pounds per square inch, and for springs of a light scale below the atmosphere at intervals of 2 or 3 pounds per square inch.

Indicators should be tested both before and after they are used on an engine or other trial. One object of testing the indicators before the trial is to make certain that there is no excess of friction, which, if present, will form double lines on the test diagrams. If double lines are found it is generally due to some irregular action of the spring in either throwing the piston of the indicator out of line, or in forcing it against the side of the cylinder. All tests, therefore, in which there are widely different lines for increasing and decreasing pressures, are in error either through incorrect adjustment of the indicator, or through some error in the standard used in measuring the pressure. A mercury column will often give incorrect results when used in testing an indicator with steam pressure unless it is allowed to stand a long time at each pressure before taking a reading, on account of the fact that a considerable pressure is required to overcome the inertia of the mercury in the column if the latter is in motion, and there may be pulsations which will affect the result. We at one time employed a mercury column in the form of a glass tube containing the mercury, and with the mercury in plain sight it required the most delicate manipulation to make the column balance at a given mark for a long enough time to obtain correct results.

In some columns the height of mercury is determined by employing electric contact points, and the lines are taken on the indicator diagrams when the top of the column of mercury touches the contact points, no effort being made to bring the column of mercury to a standstill in taking the readings. That there may be a large error in calibration made in the way can be readily shown by running the column at two greatly different speeds, in which case the results will not agree with each other.

It was stated in my paper on "A Comparison of the Mean Effective Pressure of Simultaneous Cards" taken by different indicators, presented at the New York meeting, December, 1893, that there should be no great difference in the lines for rising and falling pressures with indicators in proper adjustment. This fact has been verified by a number of special tests made since then, some of which were published in the *Stevens Indicator* of April, 1894. The fact that the lines should be the same for rising and falling pressures, with an indicator in correct adjustment, when proper precautions are employed as explained later on, may be readily verified by employing the apparatus described herein.

The apparatus used for testing indicators at ordinary pressures above the atmosphere is shown in Fig. 1. The indicator is placed at *A* on top of the cylinder *B*. The cylinder *B* is made of a piece of 6 inch standard pipe about 2 feet long. The pressure is measured by means of a plug and weight device *C*, which is spun around so as to eliminate the effect of friction. The bottom of the plug is at the same level as the pipe *D*. The U-shaped pipe *E* is filled with oil. Before starting to calibrate the indicator the petcock *F* is opened slightly, in order to allow any air in the pipe *G* and the siphon *H* to escape. The siphon *H* is surrounded by water contained in the vessel *I*, which condenses the steam which enters it through the pipe *D*, so that when all the air present is allowed to

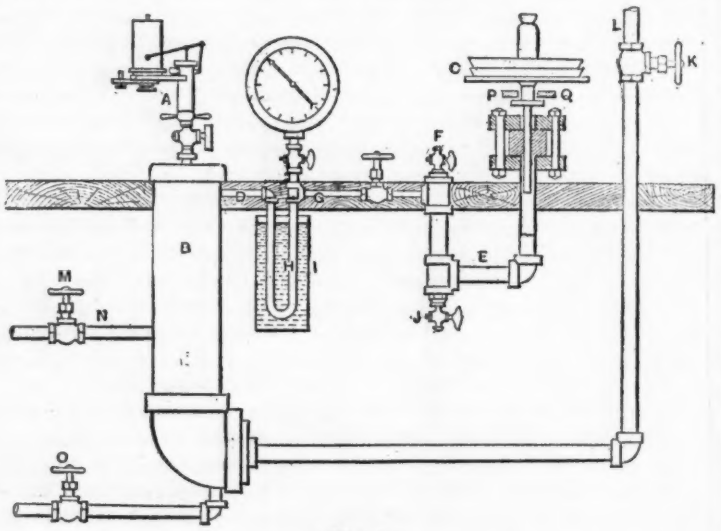

Fig. 1.

escape through the petcock *F*, the pipe *G* and the siphon *H* will be filled with water. *J* is a petcock for removing any water that may collect at the bottom of the siphon *E*, after the apparatus has been in use for a long time. The pressure is adjusted by regulating the amount of opening of the valve *K* in the supply pipe *L*, which furnishes steam, water, or compressed air to the apparatus, and also by adjusting the valve *M* in the escape pipe *N*. *O* is a valve for removing any water which may collect in the bottom of the cylinder *B* when steam is used, and for draining out the water after calibrating an indicator under hydrostatic pressure. The pan of the plug and weight device *C* is limited in its movement by means of a fork which comes in contact with it only when the pan is in the extreme positions; the two prongs of this fork are shown in section at *P* and *Q*. *R* is a gauge for showing the approximate pressure. The readings of the gauge *R* are not used in testing the indicator, but as general guide in the use of the apparatus. The diameter of the plug in the plug and weight device *C* is 0.5 inch, and the hole in the bushing 0.5005 inch. Both the plug and bushing are ground true. The average area of the plug and of the hole in the bushing is used in calculating the weight required for a given pressure.

In the apparatus, arranged as just described, one person adjusts the pressure and traces the lines on the indicator diagram. If so desired, one person may adjust the pressures, and a second trace the lines on the diagram. To arrange the apparatus for this purpose, the blow-off pipe from the valve *M* is led to a point near the valve *K*, and a second valve, for adjusting the rate of flow through the blow-off pipe, is placed near the valve *K*, where it can be operated conveniently by the party who adjusts the pressure. The apparatus which we use is arranged in this way.

The apparatus is similar to that described for testing thermometers at temperatures above 212° F. in my discussion of the paper by Messrs. Goubert and Peabody on "Throttling Calorimeters," presented at the New York meeting, December, 1895.[1]

In testing indicators with steam pressure, the steam is brought to the maximum pressure to which the indicator is to be subjected; the indicator cock is then opened and closed quickly a number of times, in order to heat the indicator. The steam is then released from the cylinder *B*, and the atmospheric line is taken after turning the indicator cock to the proper position. In taking the atmospheric line, as well as the lines for any other pressure, the pointer of the indicator is first pressed upward, and then released and a line taken, then pressed downward and released and a line taken, the indicator being rapped sharply with a small wooden stick before taking each line, as has already been explained. After obtaining the atmospheric line, steam is admitted through the valve *K*, until the pan and weight device is balanced while being rotated. This requires a very fine adjustment, and the line is not taken until there is no tendency for the plug and weight device to either rise or fall.

An apparatus for testing at pressures higher than can be carried on the boilers is represented in Fig. 2. It consists of a pipe *A*, 4 inches in diameter and about 8 feet long, placed in a slanting position, and arranged so that the lower end, from *B* to *C*, can be heated by means of Bunsen burners. The pipe *D* is connected to both a water and steam supply. Water is first admitted through the valve *E*, until it nearly fills the gauge glass *F*, after which steam is admitted, and the water in the pipe *A* is heated, and the pressure, as indicated by the gauge *G*, is brought

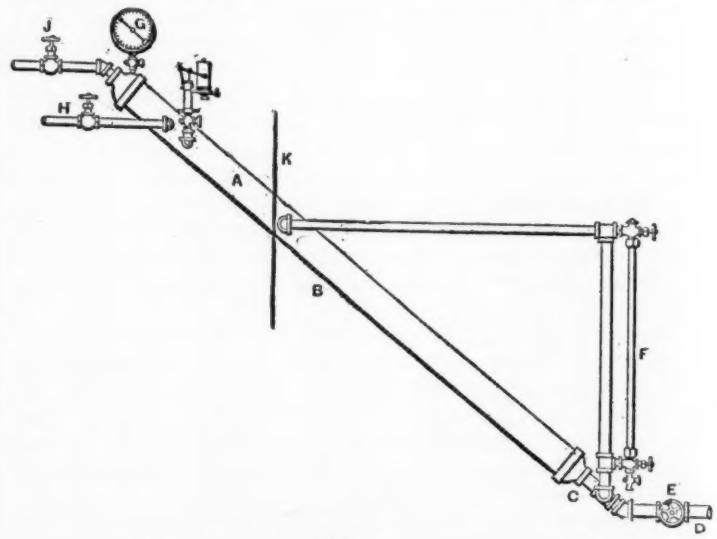

Fig. 2.

to that of the entering steam. The valve *E* is then closed, and the pipe *A* is heated by means of the Bunsen burners until the desired pressure is obtained. The pipe *H* leads to a plug and weight device, similar to the one shown in Fig. 1. The indicator is placed at *I*. In the calibration the pressure is brought to slightly above the maximum, and is then adjusted by opening the valve *J*. The first line taken is for the highest pressure, and the pressure is diminished for taking the other lines of the diagram by adjusting the height of the flames of the Bunsen burners, and the amount of opening of the valve *J*. Two lines are taken for each pressure, in the same way as described for the apparatus shown in Fig. 1. *K* is a screen for confining the heat to the lower end of the pipe *A*. The upper end of the pipe *A* is encased with a non-conducting covering, to diminish the radiation. An asbestos shield is placed on top of the lower end of the pipe to partly confine the flames of the Bunsen burners and thus render them more effective.

The apparatus employed in testing springs used under a vacuum is shown in Fig. 3. The indicator is attached at *A* to the top of the horizontal cylinder *E*. The pipe *B* leads to a vacuum chamber and pump, and slopes downward, so that no water can collect in it. The amount of vacuum is regulated by adjusting the valve *C*, leading to the air pump, and by admitting a small amount of air through the pet cock *D*. The vacuum gauge at *F* is graduated in inches of mercury and in pounds per square inch. *G* is a chamber for condensing any steam which may pass through the valve *I*, and thus prevent it from condensing on top of the mercury in the gauge *F*. The water which

1. *Transactions*, vol. xvii., p. 168.

collects in *G* is drawn off through the pet-cock *H*. The height of the mercury cup *S* is adjusted by means of the screw *U*, so that the surface of the mercury is on the same level as the zero point of the scale. There is a straight edge in front of the mercury cup *S*, at the same level as the zero of the scale, which makes it easy to adjust the level of the mercury to the proper height.

The apparatus may also be used for testing springs at pressures up to 15 pounds above the atmosphere, the mercury column *R* being used for this purpose. Where a spring is used for both a slight pressure and a vacuum, the entire calibration can, therefore, be made with the apparatus shown in Fig. 3.

In measuring a pressure above the atmosphere, the valve *I* is closed and the valve *J* opened. The pressure of the steam acts then on the water contained in the U-shaped pipe *N*, and is transmitted through the hose connection *P* to the water in the upper part of the closed bottle *Q*. The lower part of the bottle *Q* is filled with mercury, and when the pressure increases this mercury is forced upward in the column *R*. The height of the bottle *Q* is adjusted by means of the screw *T*, so that the mercury is brought opposite the zero line of the scale, a straight edge being used in the front of the bottle, at the same level as the zero line of the scale, as in the case of the vacuum gauge *F*. In adjusting the bottle *Q* up and down, the glass tube forming the column moves up and down with the bottle; this tube bears directly against the scale on which the pressures are read.

Should the pressure be accidentally raised to such an extent that the mercury will be blown out of the column, the mercury will pass through the rubber hose *V* into the bottle *W*.

In testing the indicator, it is first heated by means of steam, admitted through the valve *K*, until it attains what is considered to be about the average temperature to which it will be subjected in the test. Two

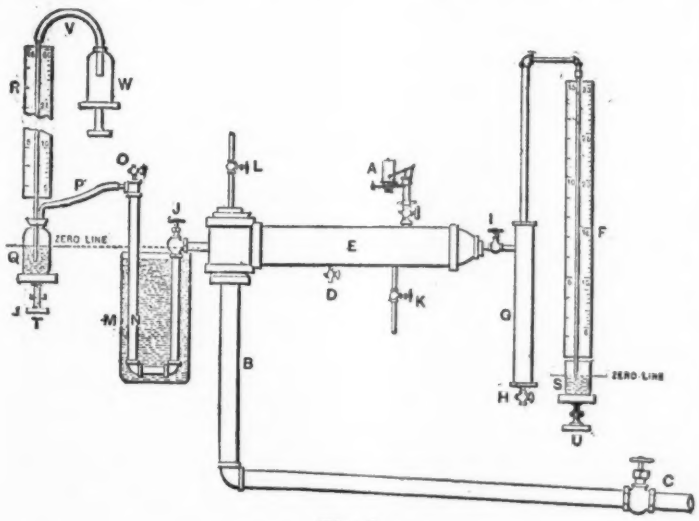

Fig. 3.

lines are taken at each pressure, and all other details in making the tests are the same as have already been described.

It has been already stated that proper precautions must be employed in tests of indicators in order to obtain lines which shall be the same for rising and falling pressures. There may be a difference found in the lines for rising and falling pressures if there is a great difference in the temperature of the parts of the indicator above the piston in taking the two lines, whereas if the temperature is made about the same for each line then one line will fall over the other. Double lines may, therefore, be obtained by starting with a cold indicator and increasing the pressure quickly before taking a line, then raising the pressure to the maximum amount and decreasing it quickly before taking a second line. The difference between the lines taken in this way with an indicator in correct adjustment will vary from about one-hundredth to a fiftieth of an inch with a 60-pound spring. If, however, the pressure is maintained for a short time at a constant figure before taking each of the lines, the lines will fall one over the other. If an indicator is tested with an increasing pressure without heating it before commencing the tests, the variation of the temperature in the spring will be much greater than that which would occur if the indicator were used for taking an indicator card from an engine, and it is to correct as nearly as possible any error due to this cause that the indicator is brought to about the average temperature in our tests before taking the atmospheric line.

A special test which can be made to show that there should not be a difference in the lines for raising and falling pressures, and to show that the results obtained by our method of testing agree with those in tests where the pressure acting on the indicator is changed quickly over the entire range as is the case when an indicator is used on an engine, is as follows: The indicator is subjected to a high pressure at the start, and the pressure is lowered, and a line taken at a falling pressure. The indicator cock is then turned quickly so as to reduce the pressure in the indicator to that of the atmosphere, and is immediately opened again, and a second line taken at the given pressure which will be a line for a rising pressure. As the temperature of the spring and mechanism is not changed the two lines will fall one over the other, thus proving that the same line is obtained for a rising and falling pressure. The atmospheric line is then taken before the indicator has cooled appreciably. The scale determined in this way will be found to be the same as that obtained by employing the method which has been adopted in our tests. In all tests of indicator springs five or more cards are taken, and the averages of the ordinates from these cards are employed in calculating the scales.

Table I. gives the results of tests made on an indicator spring by employing our usual method, with the exception that some of the tests were made at a decreasing pressure in order to show that, when proper precautions are taken, the results will be the same as for increasing pressures.

The scale of this spring when the pressure was varied quickly from the atmosphere to 100 pounds per square inch obtained by the special test which has just been described was 75 pounds, which agrees with the result given in Table I., the average of four cards which practically agreed with each other were used in computing the scale obtained by the special test.

TABLE I.—*Test of Indicator Spring, with Increasing and Decreasing Pressures.*

Conditions.	No. of Card.	Distances in Inches from Atmospheric Line to Pressures given Below. Pressures in Pounds per Square Inch. 20	40	60	80	100
Pressure increasing	1	.350	.700	1.050	1.395	1.735
	2	.365	.710	1.065	1.405	1.745
	3	.375	.710	1.050	1.405	1.750
Pressure decreasing	1	.360	.705	1.065	1.400	1.730
	2	.355	.710	1.055	1.410	1.750
	3	.355	.695	1.055	1.395	1.730
Average	..	.360	.705	1.057	1.402	1.704
Scale of spring	..	55.5	56.7	56.8	57.1	57.5
Distance from 20 pound line to lines at the higher pressures	..	....	.345	.697	1.042	1.380
Scales starting from 20 pounds line[1]	..	....	57.9	57.4	57.6	58.0

The Submerged Water Main Leading to Ellis Island.

A writer in *Engineering Record* says that the water supply for the new United States immigrant station on Ellis Island in New York harbor is purchased by the United States authorities from Jersey City, N. J., at the rate of $100 a million gallons, and is delivered through a line of 6-inch extra heavy cast iron pipe 5,400 feet long. Of this length 5,100 feet is submerged from 10 to 17 feet at high tide. The pipe sections are 12 feet 5 inches long, laying 12 feet net, and weighing 800 pounds each. The metal is three-quarters of an inch thick and Ward flexible joints are used at every length. Most of the bottom is muddy and in it a trench 10 feet wide and 5 feet deep was dug for the pipe, 300 feet long at the Ellis Island end and 200 feet long at the Jersey City end. The excavation was made by a Hayward bucket dredge, which deposited the spoil under water alongside to be used for back filling. For laying the pipe two scows 80 by 26 feet in size were braced together side by side, about 6 feet apart, and in the space between them two 10 by 10 inch skids about 55 feet long were set close together, reaching from their decks to the bottom of the trench. These formed a bed on which the pipe was assembled and jointed and from which it was lowered and deposited in position. The skids were faced on their inner upper corners with angle irons on which the pipe bells took bearing, and were connected by cross pieces 8 feet apart on the under side. The upper ends of the skids rested on and were lashed to a cross timber laid on the decks at one end of the scows and bridging the space between them. Near the other end of the scows lines were attached, which were made

1. The scales starting from some line higher than the atmosphere are used where back pressure line of the indicator card is above the atmosphere, as in the high pressure cylinder of a compound engine. The scales measured from a line above the atmosphere in this way are often more uniform than those starting from the atmospheric line on account of the end pieces, which fit over the indicator spring, becoming worn so that the spring does not bear properly against them until there is a certain amount of pressure acting on the piston of the indicator. This was the case for the indicator spring for which the calibrations are given in the table.

fast to the skids near their lower ends. By these lines the skids could be raised from the bottom and revolved to any required position about their fixed upper end as a pivot.

When pipe laying was begun the scows were moored at high tide as close as possible to the Ellis Island shore, with their axes in the line of the pipe and the lower end of the skids resting in the trench on shore. At low tide the pipe was laid in the dry up to the top of the skids, with bell ends up. At high tide the scows were warped about 24 feet off shore, and as the ways receded from the fixed pipe section the end of the pipe line slipped down on the incline until the top had nearly reached water level. Two or three lengths of pipe had then left the bottom of the skids and conformed to the alignment of the trench. Then the scows were tightly cross anchored and two more lengths of pipe were assembled and jointed on deck, lifted together by the derrick and one end connected to the top of the pipe on the skids, reaching up to the deck of the scows. The scows were warped ahead until the sections last connected slipped down the skids almost to the water level. This cycle of operations was repeated until the whole distance to Ellis Island had been traversed and the pipe had seated itself in the trench as it left the skids. The scows were anchored by one rope to a point in the pipe line ahead and by three lines on each side, seven in all, besides lines attached to the pipe at about the water level. When by reason of rough water the rocking of the scows threatened undue strain to the pipe joints, the pipe rope was slacked off and the scows were warped ahead until the top of pipe slipped down to the bottom of the skids and rested on the bottom. When work was resumed the end of the pipe was raised above water.

Pipe laying was begun September 22 and finished October 21. The maximum day's work was 43 joints, and the force employed comprised 1 foreman, 1 diver, 2 calkers and 10 other men, two of whom remained on board the scows at night as watchmen. A 2-drum steam hoisting engine and derrick was set on one of the scows to handle the pipes, which were delivered by lighters. Water was admitted to the pipe to increase its weight, and after the line was laid, air, at 15 pounds pressure, was forced in at the Jersey City end, driving out the water at the Ellis Island end and indicating by surface bubbles any leaks in defective joints, which were then calked by a diver. Afterward, when the hydrostatic test of 80 pounds pressure was made, there was a leakage of only 5 cubic feet in 30 minutes, thus more than satisfying the requirements of the specifications, which stipulated that the leakage should not exceed 1 cubic foot per minute. With a pressure of 45 pounds the metered leakage was only 3¼ cubic feet in 15 hours. The pipe was made by the Warren Foundry and Machine Company, New York City, according to the specifications of Mr. Charles A. Van Keuren, Chief Engineer of the Street and Water Board of Jersey City, and was laid by Messrs. Holmes & Cogan, No. 953 Garfield avenue, Jersey City. This work was conducted in a similar manner to the means employed by the same contractors a few years ago in laying 4,700 feet of submerged 16-inch pipe at Perth Amboy, N. J. On that work the pipe was laid in a trench dredged 5 feet in soft, black mud, and in two months portions of the pipe had sunk over 16 feet deep in it. Each joint required about 70 pounds of lead, and considerable difficulty was experienced in rough weather in pouring joints from a large pot. The rocking of the boat spilled the molten lead, unless a large gate was used, in which case it was difficult to chip off the excess lead. Finally a 2-inch outlet pipe was screwed into the bottom of the pot and fitted with a stopcock from an air brake, which had been slightly changed and furnished with a short iron nipple for its discharge. With this arrangement the pot was swung from the derrick and poured the joint nearly full. Then the flow was intercepted by a man with a small ladle, who caught 5 or 10 pounds as the pot was swung off. The stopcock was then shut and the remainder of the joint was accurately poured from the hand ladle.

An interesting modification of the principle employed in the Ellis Island work is illustrated in the laying of 900 feet of 20-inch pipe in 20 feet of water at Hackensack, N. J., several years ago. In this Mr. Holmes connected all the pipe on one bank of the stream, made the incline stationary and hauled the pipe line bodily across the channel as successive lengths were connected, the pipe ploughing for itself a channel 4 feet deep in the bed of the stream. Each length ot pipe on this work weighed 4 tons and lengths were connected by Ward flexible joints. The launching ways built on shore were long enough to receive half a dozen lengths of pipe, and when these had been connected and the joints calked the line was pulled forward until the rear end of the pipe reached the front end of the ways, leaving the incline clear for assembling another 6-length section. An increased length of pipe was moved each time, until at the last operation the whole line, weighing about 400 tons, was moved into final position. Work was prosecuted day and night to prevent the setting of the pipe line in the mud. To decrease the weight of the pipe to be hauled its buoyancy was increased by closing the end by a wooden plug and canvas gasket, and by lashing to each length four empty varnish barrels. It was estimated that a tractive force of 750 tons was required to pull the pipe at the final launching. The pipe was hauled by a Mundy hoisting engine, with two 12 by 18-inch cylinders, which was anchored to four large trees. The pipe sling was attached to a 6 part tackle of 7 inch manila rope, reeved on special 18-inch sheaves. The fall line was pulled by a 6-part luff tackle, which was also operated in turn by a second luff tackle of 5-parts, the lead line of which was given five turns around a capstan head of the hoisting engine, four turns over a second capstan head, and, finally, was tailed off by two men.

How Fuel is Wasted in Central Stations.

Mr. F. Bruton, writing in *Electricity* on the waste of fuel in central electric lighting stations, says :

This article is from a purely mechanical point of view, and is intended to show how fuel is wasted in central stations.

However insignificant a source of waste may seem, it must not be forgotten that it is one of the many, which taken together will considerably increase the coal bill at the end of the month.

Taking the boilers first, it may be said that one of the greatest sources of waste is the leakage from the safety valves. If the boilers are working under favorable conditions, there is no excuse whatever for the slightest wheeze of steam, and where the valves are allowed to blow continually at full steam pressure, or 5 pounds under, it shows gross neglect.

It is a great mistake for boilers to blow off at or about the working pressure. The safety valve should be regulated so as to lift at 5 pounds above the working pressure. This will give the fireman a chance to "burn down" and "clean" his fires without letting the steam down below the working pressure, and avoid blowing off.

Nothing is more distracting and confusing than steam roaring away; more often than not there is quite enough noise in the engine room without the aid of the boiler house.

The rule allowing a margin of 5 pounds does not hold good if the safety valves are not tight on their seats. A badly seated valve will blow considerably below the working pressure.

These valves require grinding in with fine emery powder from time to time.

The operation is one which needs a fair amount of skill, and should be done by a mechanic—not the fireman.

The practice of putting weights on the lever of a safety valve, in order to prevent steam escaping, is not only useless, but dangerous. Grinding in is the only remedy.

A disadvantage of lever safety valves is that they may be tampered with in this way ; but with spring-loaded valves, when once set and locked up, they cannot be altered in any way, and should a partible of dirt get between the valve and seating, causing steam to blow, a slight twist of the spindle will often stop it.

The blow out apparatus is sometimes responsible for a good deal of waste. When a boiler is laid off for cleaning, etc., the blow-out cock should be examined, and if necessary, ground in.

If the plug leaks it will be corroded and show signs of unequal wear. Before replacing the plug after grinding in, it should be rubbed over with black lead and tallow, as this greatly facilitates its working when in use.

The waste pipe from the blow-off cock should be placed where any leakage can be detected.

The undue formation of scale and neglect in cleaning a boiler is another source of waste. Every engineer knows that a certain amount of scale is beneficial to a boiler, as it protects the plates from the injurious effects of impure feed water; but when it becomes too thick it not only wastes fuel, but may cause the furnace crowns to overheat.

A boiler should be laid off for inspection about every month or six weeks, all superfluous scale removed, and flues cleaned.

Soot is a non-conductor of heat, and therefore fuel is wasted when the flues are dirty.

Bad firing means waste of fuel.

Men are sometimes employed who are mere novices at firing, with the result that they waste a large quantity of good fuel, especially when cleaning fires. It is far better to engage men who are experienced.

Leaving the boilers, waste may be looked for in the following: (1)

Leaky joints; (2) steam traps; (3) leaky slide valves and glands; (4) running large engines underloaded.

Joints are often allowed to blow until they get so bad that they are nuisances, drowning any noise about the machinery which may warn the man in charge that something is wrong. When a joint begins to blow it might as well be made at once, for it's only a matter of time till it becomes a necessity. A good joint for steam piping is a corrugated metallic ring, spread with putty or cement.

The disadvantage of using asbestos is that unless a joint is screwed up once or twice after making, the expansion and contraction of the steam piping are apt to loosen it and it soon begins to leak again.

Asbestos is more suitable for covers, blank flanges, etc. Steam traps frequently do more than is required—they pass steam in addition to water.

A far more economical arrangement is an intercepter or catch-water. This consists of a vessel fitted with a plate three quarter way down the middle. The water coming through with steam impinges against the plate and falls to the bottom, the steam passing down under the plate and out at the top on the other side. The vessel is also fitted with a water gauge and drain cock. Every now and again the water is blown out into the feed water tank. Leaky pistons and slide valves are often met with, due to the fact that they are not looked after to the same extent they should be.

Speaking generally, there seems to be a want of mechanical knowledge in central stations, and the common impression is that as long as the electrical portion is all right it does not matter about the mechanical part. But here is a grand mistake—the mechanical is the more important. It has been said, and not without reason, that a man is an engineer first and an electrician after.

Leaky valves not only waste fuel, but they upset the governing arrangements of an engine. In a compound engine the steam passes the valve into the low-pressure side, causing this side to do more work than it would if the slide valve was steam tight.

An engine should be indicated periodically, and if the slide valve leaks it will be seen by the expansion line on the card rising, instead of falling gradually to the point of cut-off.

The remedy in this case is to reface the valve, or if a piston valve, to fit new springs or reline valve chamber.

The practice of running large engines at light loads is to be condemned. As soon as the load falls to the full output of the next size set it should be thrown on to it. If there is any doubt about the engine being unable to do the load for which it was designed the engine ought to be tested, the sooner the better.

The causes of waste of fuel in central stations recited above do not cover the whole of the ground. It would be absurd to do so exhaustively here; but it is intended to show the waste which very often goes on during the ordinary running of a station.

Much might be written on waste due to bad design, but that would be opening up fresh ground, and altogether out of the scope of the present subject. When plant has once been laid down it is rather a difficult as well as an expensive matter to rectify errors of judgment.

Reflection of Light.

The *Builder* (London, England), in its "Student's Column," is publishing a most interesting series of articles on "Sound, Light and Heat." The 19th chapter of the series treats of the reflection of light, and the story it tells is as follows:

The laws appertaining to the reflection of light are, practically, the same as those for heat. When a ray of light falls on a polished surface it is reflected as follows:

1. The angle of reflection is equal to the angle of incidence.
2. The incident and the reflected ray are both in the same plane with the perpendicular to the reflecting surface.

In regard to multiple images formed by glass mirrors Ganot remarks that whenever light is transmitted from one medium to another, only some of the rays get through; the remainder are reflected at the surface bounding the two media. The student will remember that almost the same effect results from the reflection of sound when a sonoriferous beam is passing through media of different densities. The multiplicity of images is objectionable in observations, and, accordingly, metal mirrors are much to be preferred for accurate scientific work.

In spite of the general laws of reflection, just enunciated, it is known that the light incident on an opaque body separates into three parts, viz., one part is regularly reflected according to those laws, another is reflected in all directions, whilst the third is absorbed by the body on which it falls. That part which is scattered in all directions is known as scattered or diffused light. Ganot observes, that the light which is reflected regularly, does not give us the image of the reflecting surface, but that of the body from which the light proceeds. If, for example, a beam of sunlight be incident on a well-polished mirror in a dark room, the more perfectly the light is reflected the less visible is the mirror in the different parts of the room. The eye does not perceive the image of the mirror, but that of the sun. If the reflecting power of the mirror be diminished by sprinkling on it a light powder, the sun's image becomes feebler, and the mirror is visible from all parts of the room. Perfectly smooth, polished reflecting surfaces, if such there were, would be invisible. The beam of light itself is only seen in the room owing to irregular reflections from the particles of dust, and the like, which are floating in the air. Tyndall has shown that when this floating matter in the air in an enclosed space is completely removed the beam of the sunlight or the electric light is quite invisible. The atmosphere diffuses the light which falls on it from the sun in all directions, so that it is light in places which do not receive the direct rays of the sun.

From what has already been said, it is evident that the intensity of the light reflected is always less than that of the incident light; the intensity increases with the obliquity of the incident ray.

A practical application of reflection from the surface of a flat mirror is employed in the measurement of small angles. In one instrument for this purpose the mirror being carefully adjusted in position by means of a telescope is made to reflect a spot of light which is seen at one end of the object to be measured; the source of the spot is then caused to move with the mirror whilst the latter is slowly revolved until the light spot arrives at the other end of the object. By a simple contrivance the number of degrees through which the mirror has been turned, which also gives the measurement of the desired angle, is readily ascertained. Another practical application is the heliograph, for reflecting light to distant stations; the signaller can deflect the mirror through a very small angle either to the right or left, and the observer at the distant station sees corresponding flashes, so that a code being arranged messages may be flashed over long distances. In a similar manner the electric search light is also utilized for flashing signals either direct or by reflection from the clouds.

The reflection of light from curved surfaces is not quite so easy to understand—at any rate, at the first glance. Curved mirrors are of various kinds, but those most frequently used are either spherical or parabolic. One of the prime objects of the curved concave mirror is to collect the rays of reflected light into a single point, and to intensify the light at that point; or, a number of rays may be reflected to different foci, so that there shall be several points of "intensified light" from one mirror when the reflecting surfaces of the mirror shall be arranged accordingly.

In reference to parabolic mirrors reflecting on the concave surface, all rays parallel to the axis after reflection meet in the focus of the mirror, which is situated in the center of, and near the surface of, the mirror. On the other hand, when a light is placed in that focus, the rays incident on the mirror are reflected parallel to the axis. Light thus reflected maintains its intensity for a great distance. Practical applications of the parabolic reflector are in lighting dark staircases and passages. By an arrangement of two or more such reflectors the rays from a single light may be reflected in different directions, as required. This form of reflector is also used in carriage lamps, and for the head and tail lights of railway trains.

Perhaps the greatest use of the parabolic reflector is for lighthouse purposes, though in lighthouses of the first order the method is now largely superseded by lenses, as will hereafter be described. In 1867 the parabolic metallic reflector was used in 180 lighthouses in the United Kingdom, or about one-half of those erected at that date. The idea of its application to sea lights, however, dates back to the year 1784, following on the discovery of the cylindrical burner with its double current of air. It was found that the chimney of that burner which was essential to perfect combustion, served likewise the indispensable purpose of carrying off the gaseous products, which, in previous forms of lamps, by tarnishing the surface of a reflector, rendered its adoption quite useless. Argand, about the year mentioned, perceived the applicability of the parabolic reflector for sea lights. Quite independently, the engineer of the Northern Lights Board made a parabolic reflector of facets of silvered glass fixed in a plaster mould, which was erected in 1787 at Kinnairdhead, in Aberdeenshire.

Brewster showed how much greater is the loss of power when rays are reflected from a metallic surface, especially if hammered into shape (as in the case of the ordinary parabolic reflectors then in vogue), than when transmitted through glass lenses or prisms of moderate thickness.

Mr. J. T. Chance, C.E., observes that apart from these considerations the lighthouse reflector gives place to the dioptric instrument for two other reasons mainly. First, the parabolic mirror irremediably causes great waste of light, and therefore of oil, by useless divergence; secondly, it is only by an enormous multiplication of reflectors, far beyond what, in the presence of a better system, engineering principles would justify, that the power of dioptric sea lights can be rivalled. Theory and experiment concur in this result.

Mr. Thomas Stevenson placed a lenticular front upon the parabolic mirror, so as to condense the cone of light which would otherwise pass off in its natural state of divergence; and in place of the corresponding back portion of the reflector, he substituted a spherical metallic mirror, which returned the flame upon itself though inverted. Let it be assumed that, with this modification of Mr. Stevenson, the proportion of the luminous sphere, which the parabolic mirror and its adjuncts condense, is equal to that which is embraced by a complete dioptric instrument; still the defect of wasteful divergence remains. Mr. Chance (*Op. cit.*, p. 495) remarks that there is a practical limit to the dimensions of the reflector; and perhaps it would be found inexpedient to extend the size beyond that of the Scotch instrument, the aperture of which had a diameter of 25 inches. If, again, with a given maximum size of reflector the diameter of the burner be enlarged without the introduction of a further wick, there will be a corresponding increment in the divergence of the beam, but very little, if indeed any, addition to its mean intensity.

In order to obtain an intensity of illuminating power at all approaching that of a dioptric instrument of the higher orders, there was no resource but to multiply the number of the separate reflectors. For the purpose of estimating the exact multiplication of reflectors which would be required, recourse must be had to experiment. M. Fresnel drew up an elaborate account of the comparative advantages of the system of metallic reflectors and dioptric instruments for sea lights; and a later author, M. Reynaud, made a very careful comparison, based upon actual photometrical observations. He showed that a Fresnel light of the fixed kind, even of the second order, can be equalled by reflectors only by multiplying them to the number of 60, each giving about the same quantity of light in the horizontal plane as the English reflector; and that the consumption of oil would be seven times more in the em ployment of these reflectors than in the case of the dioptric apparatus. In England a fixed light of reflectors had them, generally, in the proportion of 24 to 27 in number for 360°. Yet, even with all this multiplying of reflectors, the perfection of uniformity in the distribution of light over the horizon, which accompanies the fixed dioptric light, cannot be imitated by parabolic mirrors.

From the foregoing estimate of the number of reflectors required for an apparatus which would be equal in power and general effect to a first order dioptric fixed light, it may be calculated, approximately, what arrangement of reflectors would be necessary in order to produce the effect of a first order (1867) dioptric revolving apparatus.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

The authorities of South Williamsport, Pa., have ageed to permit the Williamsport Gas Company to extend its mains into and through their territory.

At the annual meeting of the Aurora (Ills.) Gas Light Company the Directors chosen were: W. S. Beaupre, E. A. Bradley, E. W. Trask, C. C. Smith, S. D. Seaman, J. H. Pease, J. O. Mason, E. S. Hobbs, E. H. Day, C. E. Colwell and I. C. Copley.

The Otto Gas Engine Works proprietors received the gold medal for the excellence and superiority of their gas engine exhibit as shown at the Omaha Fair. The honor is by no means an empty one, for many other makes of gas engines were shown in the competition.

Mr. George W. Graves, writing to the Journal, from Rochester, N. Y., under date of November 26th, says:

To the Editors American Gas Light Journal: At the last meeting of the American Gas Light Association, when making some remarks in reference to the gas range business, I offered to furnish any member a copy of the contract that is used by the Rochester Gas and Electric Company, under the terms of which contract the Company has put out in the city over 5,000 ranges. Judging from the number of requests I have received for a copy of the contract, I concluded the easiest and best way to reply to all was to have it published in the American Gas Light Journal, therefore I send it to you. The specifications of the contract are:

"'No. 8,041. Rochester, N. Y., ——, 189 .

"'In consideration of the Rochester Gas and Electric Company allowing me the use of a gas range, at No. —— —— street, I agree to comply with the following conditions:

"'1st. That the bill for connecting stove shall be paid within 30 days after the completion of the work.

"'2d. That the minimum charge for setting up stove shall be $1.

"'3d. That I will use in said stove each calendar year an average of at least 500 cubic feet of gas per month.

"'4th. That I will take all reasonable care of said stove and will be responsible for any damage which it may suffer, other than ordinary wear, while in my possession, my responsibility ceasing only upon the Company's examination of the stove and giving me a printed release.

"'5th. The stove shall not be removed from above location without permission of the Company.

"'6th. The Company reserves the right to remove the stove and meters for non-payment of gas bills, or default of any of the above conditions.

"'7th. And I expressly agree to pay the difference if I fail to burn, each calendar year, the amount of gas above specified.'

"This is practically the same form of contract that is used by the Albion (N. Y.) Gas Company; the Middletown (N. Y.) Gas and Electric Company; E. C. Perry & Co., of Dunkirk, N. Y.; the Monroe County Gas Company, Stroudsburg, Pa.; the San Francisco (Cal.) Gas and Electric Company; the Wright Gas Company, of Lorain, Ohio; and a number of other companies in different sections of the country. The past three years' experience of the Rochester Company has demonstrated the following facts: That the average amount of gas consumed by the contract ranges is over 15,000 cubic feet per year; that the consumers are satisfied to take whatever pattern of range is given them; that a range which has been returned can be put in order and sent out again at a small expense; and that there is no more complaint from contract ranges than from those that customers had bought and paid for prior to the inauguration of the contract plan. Nor do the customers insist that the Company shall put out any particular style of range. The Rochester plan has demonstrated the fact that it is easier to collect pay for connections than it is to sell ranges; that in most cases the landlords, as a rule from necessity, will pay for the connections. That no unusual amount of advertising is required to place at once a quantity of ranges; and that the consumers regard the contract a liberal one. I trust this will be of some benefit to the gas fraternity."

Mr. A. W. Dow, inspector of asphalt and cement street paving for the District of Columbia, was recently directed by the authorities to investigate and report upon the suggestion that leaks from gas mains resulted in the deterioration of asphalt pavements. Mr. Dow seems to have made some sort of investigation, for he is on record as replying that "pavements may be destroyed in 6 or 7 years" by the constant rising of small amounts of gas from defective pipes; but Mr. Dow's determination or conclusion is woefully at fault, if the complaint that has been voiced by scores of gas engineers during the past dozen years or so may be credited. Their greatest complaint against a properly laid asphalt pavement is that its thoroughly impervious nature forces gas escaping from imperfect mains, along and through earth levels many times greater in length than the height of the earth between the main and the bottom of the pavement, until it finds exit into areaways and cellars, even though "it had to follow cleavage lines in the mortar of stone or brick walls to 'get there.'" Most everyone appreciates the poor quality of the asphalting that was done on the streets of Washington, but it was an erratic genius who conceived the excuse that its present rottenness is due to the solvent action of escaping gas. In any event, the gas engineer, if offered choice in the premises, would undoubtedly elect to take his chances with asphalt pavement of the Washington type, rather than suffer from the effects of the asphalt pavement construction of the New York city sort.

A week ago we had occasion to remark that some of the authorities of Somerville, Mass., proposed to make a trial of Welsbach lamps on the streets to the end that such lamps might be substituted for the incandescent electric lamps hitherto largely used for the named purpose in Somerville, provided it were shown that the Welsbachs were superior in illuminating value to the 32-candle power lamps, nominal, maintained by the Somerville Electric Light Company. Mayor Perry thought, however, it would be wise to refer the matter to the Superin-

tendent of Lights (Mr. Edward Backus) for an opinion as to the lighting value of the two types of lamps, which course was agreed to. After due deliberation the Superintendent submitted the following queer document, which is given verbatim :

"I have been requested by his honor the Mayor to make a test of the Welsbach and 32-candle power incandescent lamps to ascertain which was best adapted to street lighting. Now, the test of these lights is not which gives us the greatest candle power, but which gives us the best lighted streets. We know the Welsbach claim a light of 64 or more candle power and the incandescent of 32, so that a photometric test for candle power would result largely in favor of the Welsbach. This is not the test which would demonstrate the relative advantage of one light for another for street service. It is a well-known scientific fact that what is known as the red ray in light has a much greater penetrating quality than any other ray. The incandescent is very rich in this, while the Welsbach has a small percentage of the same, and although the Welsbach gives apparently a very bright light its penetrating qualities are comparatively poor. One test which I have applied, and a very simple one, which any of you can try, is, to take an ordinary sheet of white paper, with a line drawn across it in *ink*, and cover the same with three or four sheets of thin brown paper and try the distance away from a Welsbach light this line can be distinguished when looking through a tube, and then apply the same test to a 32 lamp. The result of this test shows four incandescent lamps, 57, 45, 60 and 63, making an average of 56¼ feet for each light. Two of the Welsbachs, burning Cambridge gas, showed at 51 and 42 feet, and two, burning Charlestown gas, showed at 42 and 57 feet, making an average of 43 feet. Another test tried was to stand equi-distant from each kind of light and hold a pencil upright on a level surface. If both lights were equal the two shadows would be of equal density. In the actual test the shadows appeared the same at a point 3 feet nearer the Welsbach than the incandescent, and, from the tests shown, the 32-candle power incandescent has the greater penetrating power, and, in my opinion, is best adapted for lighting our streets."

It is unfortunate that the Superintendent did not specify the color of the ink that should have been put on the "ordinary sheet of white paper" covered with "three or four sheets of thin brown paper"; but we presume red would have done as well as anything else. The "authorities," having heard the report, were evidently in a quandary; for, on motion of Ald. Davlin, the subject was again laid on the table, so that representatives from the two Companies might submit the results of tests in which ink, white and brown paper, were not so prominent.

The proprietors of the Wooster (O.) Gas Light and Coke Company, objecting to the overcharges made them for a water supply on city service, have arranged for their own supply by pumping from a tributary of Killbuck creek.

The Plymouth (Mass.) Gas Light Company has purchased a plot of land, from Mr. W. S. Danforth, adjoining its premises on Howland street, for purposes necessary to the Company's development.

The Corning (N. Y.) Heat and Fuel Company has asked for a franchise for the right to supply natural gas in the city named. From current indications it would seem that the application was not made in good faith.

The proprietors of the Bangor (Me.) Gas Light Company report a large increase in sendout. The extensions to and improvements on the plant are about completed.

The Winnepesaukee Gas and Electric Company has demonstrated to the citizens of Laconia, N. H., the complete serviceability of the Welsbach burner for purposes of street lighting.

The Clyde (N.Y.) Gas and Electric Company has issued a mortgage of $25,000, the Trustee being the Trust and Deposit Company, of Onondaga. The rate of interest is 6 per cent. per annum.

The proprietors of the Bangor (Me.) Gas Light Company propose to increase the capital stock to $50,000.

The proprietors of the Elmira (N.Y.) Gas and Illuminating Company have expressed their satisfaction over the capability shown by General Manager J. B. Cahoon in his direction of the improvements made on the plant.

The matter of the purchase by the authorities of the Beverly (Mass.) Gas and Electric Light Company's plants, for operation on municipal account, proceeds slowly.

The semi-annual dividend of 2½ per cent. on the preferred shares of the Laclede (Mo.) Gas Company is payable the 15th inst.

The proposition for the establishment of a municipal gas plant at Buffalo, N. Y., does not seem to be urged with that vigorousness which disinterested motives would imply. At the present time the ostensible hitch is that a suitable site cannot be obtained. Yet the municipalists must admit that there are many uncovered acres in Erie county.

The Kansas City (Mo.) *Times* says that the official gas inspector of that city (Mr. McClure) "does too much inspecting."

Last week we referred briefly to the report of the Board of Arbitration named by the authorities of Covington, Ky., to value the properties of the Covington Gas Light Company, and in consonance with our promise to give this week a full account of the case, we hereunder tell the story, as it appeared in the Cincinnati (O.) *Tribune:* "An event of considerable interest to the people of Covington occurred when the Board of Arbitration, selected to determine the value of the gas plant and franchise of the Covington (Ky.) Gas Light Company, made their report to the parties interested. The arbitrators, selected only after long and bitter litigation between the authorities of Covington, the Suburban Electric Light Company, of Covington, and the Gas Light Company, were: Mr. J. D. Hearne, of Covington; Mr. Alex. Humphreys, of Louisville; Mr. E. C. O'Rear, of Mt. Sterling, Ky.; Mr. J. K. Stone, of Newport, Ky.; and Mr. Samuel Stone, of Frankfort, Ky., and these gentlemen, after hearing protracted, minute and definite testimony, which was subsequently weighed and analyzed with care and independence, gave their opinion that the Company was entitled to the sum of $450,000 for the gas works and all pertaining thereto, and to the further sum of $36,000 for the franchise for the unexpired term of nearly four years. The main contention between the two interests represented was on the question of the value of the good will, the attorneys for the Electric Light Company contending that no valuation could be placed on it. The arbitrators, however, counted the good-will as part of the assets, which precedent will undoubtedly later on serve others connected with the gas industry of Kentucky in good stead. Over 1,000 pages of testimony from experts were on the record by which the determination was made. The ending of the work of the arbitrators marks the last step but one in a celebrated struggle for the control of the street lighting privileges in Covington, a contest begun three years ago. The Covington Gas Light Company had a 50-year contract with the city of Covington for the exclusive right to light a major portion of the streets of that city. One clause of the contract gave the city the right every five years to offer for sale the franchise of the Company, the city to receive whatever was offered for the franchise. If there was a bidder the latter had the right to select two arbitrators, the Gas Light Company two, these four to select a fifth, the five to determine the value of the plant. Their decision was to be final, the purchaser of the franchise being compelled to pay, and the Gas Light Company to accept, the price named by the arbitrators. About two years ago the city determined to avail itself of the right to sell the franchise, there remaining but five years of the 50-year contract. The Gas Light Company resisted the sale on the ground that, as once before the city had availed itself of its right, the Company submitting to an appraisal, but, after arbitrators had been appointed, the would-be purchasers declined to carry out their agreement, hence the city had forfeited its right in the future in the premises. This contention was held not good by Circuit Judge Tarvin, after a celebrated legal battle between the City Attorney (Shaw) for the city, Judge Helm and C. H. Shaw, for the Suburban Electric Company (purchasers of the franchise), on the one side, and Judge Warrington and Governor Bryan for the Gas Company. The latter appealed the case to the Court of Appeals, where it is pending. Should that tribunal uphold Judge Tarvin's decision the Electric Company must pay the sum named by the arbitrators, they to receive therefor the entire possessions and rights of the Gas Company. Should the decision be reversed the whole matter ends and the Gas Company will light Covington's streets for nearly four years, or until the expiration of the 50-year contract. The Suburban Electric Light Company, as the purchase price to the city for the franchise, agreed to light the principal streets of Covington with electric light, and also to equip the court house, jail and police station with electric light for a year free of charge. That part of the contract the

Company is now carrying out, and must fulfil until the end of the year's time, regardless of the decision of the Court of Appeals. It also insures the city from damage from the Gas Company by reason of the discontinuance of the use of gas on the streets where electric lights have been placed. The decision of the arbitrators is a decided victory for the Gas Light Company, so far as the valuation is concerned; for it was reported at one time that the owners of the Gas Company offered to sell outright to their competitors at a price practically the same as that agreed on by the arbitrators, but the offer was refused. The President of the Suburban Company is Mr. Archie Stewart, and the President and chief owner of the Gas Light Company is Mr. Bradford Shinkle. It is expected that now that the abitrators have decided upon the value of the plant, the Court of Appeals will be pressed for an early decision of the case before it. Messrs. Hearne and Humphreys were the arbitrators for the Gas Light Company, and Messrs. Stone, of Newport, and O'Rear, of Mount Sterling, were for the Electric Light Company. Auditor Sam Stone was agreed upon by the four for the fifth man."

AT the semi-annual meeting of the Portland (Me.) Gas Light Company a dividend of 4 per cent. was declared. It was also decided to raise the price of coke (delivered) to 12 cents per bushel.

THE all-night electric lighting service of the Stockton (Cal.) Gas and Electric Company has been successfully inaugurated.

MR. DUPONT WALKER, the clever Secretary of the Dover (Del.) Gas Company, is no longer a bachelor. The ceremony which joined the fortunes of Miss Leila Cole (the charming daughter of Mr. and Mrs. Amos Cole) to his was performed by the Rev. Geo. M. Bond, of Dover, on November 23d.

THE City Council of Galt, Canada, has decided to submit a bye-law, to be voted upon by the ratepayers the 17th inst., which calls for the raising of $67,750 for the purchase of the gas and electric plants of the Galt Gas Light Company.

THE gas rate at San Bernardino, Cal., has been placed at $3 per 1,000 cubic feet.

MAYOR MCKISSON, of Cleveland, Ohio, is quoted as holding to the belief that the Cleveland Gas Light and Coke Company's agreement with the city obliges it to manufacture and distribute coal gas only. If our recollection is not at fault the agreement merely stipulates that "illuminating gas" shall be supplied.

THE affairs of the Anniston (Ala.) Gas and Light Company are taking such shape that Mr. Sexton and his associates are satisfied that the properties will shortly be removed from the custody of the receiver. The latter, by-the-way, has done well with the Company since it came under his control.

Excerpts from the Address of Mr. C. W. Hunt, President of the American Society of Mechanical Engineers, on the Occasion of its New York Meeting.

It has long been evident that we are making rapid progress in perfecting our manufacturing machinery, as well as organizing and developing our industries, thus constantly increasing the efficiency of our labor, until we have lately reached a point where an hour's labor with its facilities produced more of our principal products, and transported them farther, than an hour's labor would do in any other part of the world.

The late war has revealed to us the fact that we have gone on reducing the cost of our products, and increasing our capacity for production, until our country alone does not furnish a sufficient market to insure steady work for our labor, and prosperity for our merchants and manufacturers. Like confined waters, the tendency of these economic forces has been to break out from their confinement and equalize trade conditions by seeking a market in the world outside. If articles which are necessary to supply the wants of man can actually be made with less labor and cheaper here than elsewhere, here they will surely be made, though it modify our traditional ideas of isolated position, and our protective theories. One hundred years ago the iron trade of Sweden was greater than that of England, and remembering the great changes which have taken place in the last hundred years, it would be rash to assume that the momentous economic changes which are now taking place, may not cause an equally great shifting of the centers of more than one phase of industrial activity.

The Advent of the Engineer.—Turning now to the effects of this accumulation of scientific literature available to all alike, and the results following its application by organized methods of procedure, our first glance will show prominently the wonderful and rapid increase of the importance of engineering in our industrial life. It has transformed almost every phase of it, and put into our hands materials and processes which make the actual life of our immediate ancestors seem primitive by comparison.

Commencing under adverse conditions and developing in a field of restricted capital, with scarce and high-priced labor, engineering in America has applied the forces and materials of nature to the uses of man in a characteristic way. Freedom from mediæval traditions and the hampering conditions found in the older countries, left them substantially free in the choice of means to accomplish their end. Influenced as our engineering has been by the experience and the work of other parts of the world, yet we cannot escape the fact that its development was essentially independent, and in some phases unique. Improvement has followed improvement in technical matters, profits and savings have been added to the capital invested in our industries until the continent, 200 years ago an untraversed wilderness—100 years ago a struggling nation—struggling with industrial difficulties and serious political problems—has triumphed over these early limitations, and has developed into a nation which, in numbers, prosperity and wealth takes a prominent position among the great nations of the world.

Whichever way we turn, we are met by a scene of marvelous changes, which have followed the advent of the engineer on the scene. A view of one subject will in a measure serve to represent these changes, and to recall similar illustrations to your minds which differ from this only in degree.

It is but a few years, well within the memory of men now living, that our navy and all the other navies of the world were composed of sailing ships. In one of these vessels a mechanical germ was introduced in the form of a steam engine and an engineer. The grave question soon arose as to what should be the status of the new intrusion into the personnel of the ship, the engineer. This factor, which was soon to revolutionize the navy, was considered quite important at that time, as is shown by the first official record on this subject in the Navy Department at Washington, stating that it would seem that such persons should be exempt from the penalty of corporal punishment.

The engine grew in size with each succeeding vessel, and as it increased, the sails correspondingly shrank, until finally they disappeared altogether. New mechanical germs soon found a lodgment in other parts of the ship, which in a few years have so developed that hydraulic and pneumatic pressures are produced, and electric currents are generated and distributed, to govern the rudder, hoist the anchor, ventilate the compartments, energize the combustion, revolve the turrets, train and control the guns, handle the ammunition, and purge the ocean's water of its impurities, making it wholesome for the ship's use. Following these in quick succession came incandescent lamps and search lights, breech loading and rapid-fire guns, multi-charge automatic guns and mobile torpedoes, one mechanical appliance rapidly following another, until the sailing ship of the line, which but just now embodied the result of hundreds of years of thought and experiment, has been completely transformed from keel to topmast into a vast machine, controlled and operated even to the least important function, not by sailors, but by mechanicians.

In every phase of our industrial life the changes wrought by the engineer are quite as evident; for instance, note the changes in the manufacture of steel, development of electric locomotion, in iron construction in buildings, in machine tools, in agricultural implements, in sewing machines, in textile industries, and in electric metalurgy.

Effect on the Mind and Character.—The life of the engineer has a full measure of the labors, the trials, the discomforts and the disappointments which are found in this, as in every other walk of life. But it also has the successes which come from well-directed labors. It is not, however, either the useful work or the successes of life which bring happiness. It is man's ideals which make him happy. Let us together survey some of the surrounding influences which tend to give high ideals of life to the engineer, no matter what the vexations of the moment may be. We will pass in review the interesting character of his daily work, his pure-minded associates, the fascinating scenes and the higher pleasures of life by which he is surrounded. We will then better appreciate with what elevated emotions a father can lead a son, or a teacher his pupil, to the path of an engineering life, and place in his hands the mathematical, chemical and physical implements to enter upon a work which will bring him both pleasure and honor.

Whichever way engineering may develop as time rolls on, its elevating influences are constantly at work on the mind and on the character. The work is carried on under unchangeable laws, which must be rigorously applied and adhered to, or failure is sure to result. Man builds to master, to resist, or to guide the forces of nature. If he has rightly judged the conditions, his work stands as a permanent monument of the fact; but if otherwise, the irresistible laws of nature will develop the defect and discover his ignorance, incompetence or error to every observer.

Hence he laboriously seeks out the unseen laws and forces, then expresses the revelation in a workable form for his daily use. He tests his materials with painstaking refinement. He measures electric resistances with an accuracy now reaching the point of one in four millions, time to the one three-millionth part of a unit, divides a circle with a mean error not exceeding the one-millionth of the circumference, makes surfaces 6 inches square with a variation from absolute flatness of less than $\frac{1}{3000000}$ of an inch, rules lines which vary from absolutely perfect spacing by $\frac{1}{3000000}$ part of an inch, sees clearly the spectrum of samarium when one part is diluted with 3,000,000 parts of lime, and surveys lines 11 miles long in the open air, with an average variation in three measurements of only $\frac{1}{10}$ of an inch.

THE AMERICAN GAS LIGHT JOURNAL

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THOS. J. CUNNINGHAM,
ELBERT P. CALLENDER,
EDITORS.

CHAS. E. SANDERSON,
MANAGER.

MONDAY, DEC. 5, 1898.

The Market for Gas Securities.

The market for city gas shares developed unusual animation during the week, Consolidated selling up to 197½ this morning (Friday), which quotation is also ex-dividend of 2 per cent., payable the 15th inst. The upward movement extended to the other city shares, even Amsterdam taking on a point from the figures of last week. Mutuals is 320 bid, and Standard common is 138 bid. The end of the row in New York is close at hand.

Brooklyn Union is 128½ to 129; Peoples, of Chicago, is 110⅛ to 110¼. Bay State is 4⅜ to 4½, and Baltimore Consolidated is 65 to 66. The Newark (N. J.) redeal is completed. Under it the succeeding Company is named to carry a capital load of something under $23,000,000.

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DIVIDEND NOTICE.

OFFICE OF WELSBACH COMMERCIAL COMPANY,
40 WALL ST., NEW YORK CITY, Nov. 17, 1898.

The Directors have this day declared a dividend of one (1) per cent. on the preferred stock, payable December 10, 1898, to stockholders of record at the close of business Nov. 30, 1898. Transfer books of the preferred stock will be closed from Dec. 1 to Dec. 10, 1898, both inclusive. Checks will be mailed

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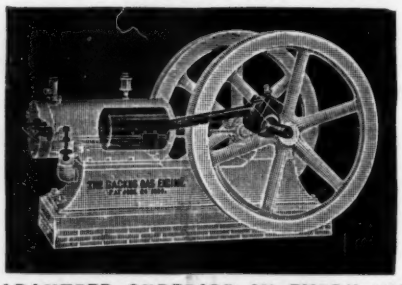

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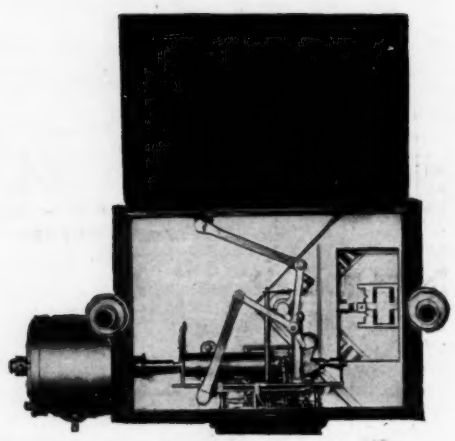

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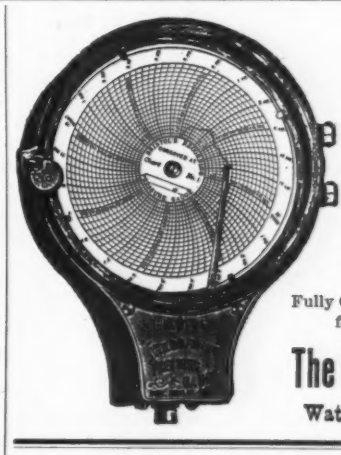

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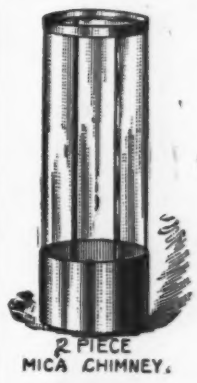

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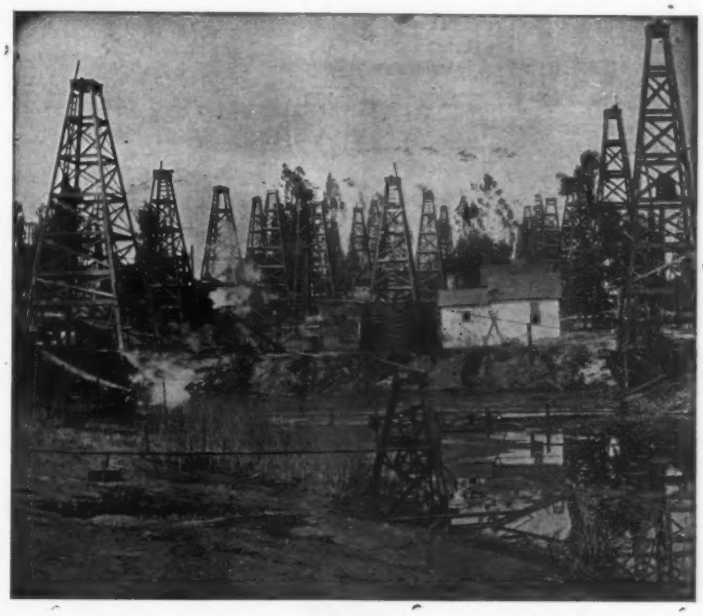

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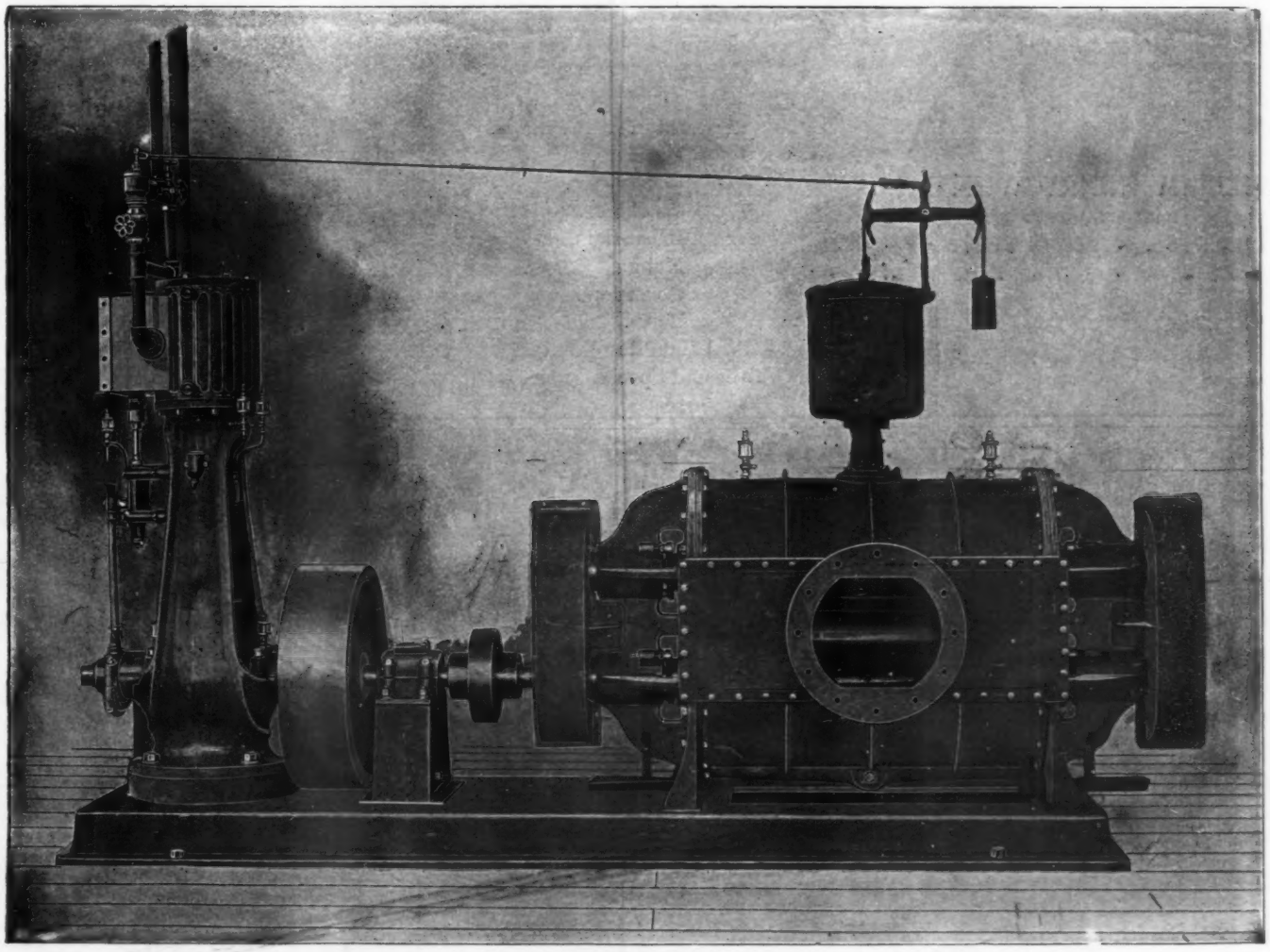

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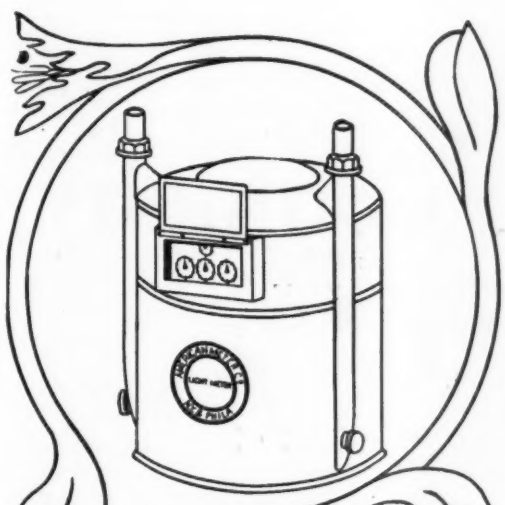

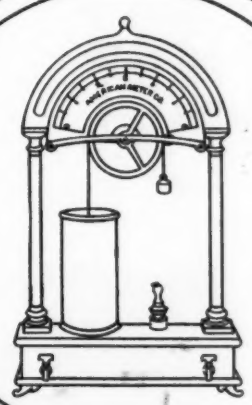

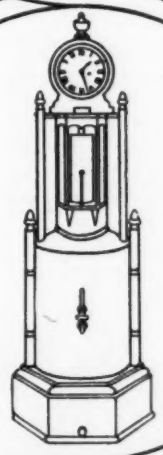

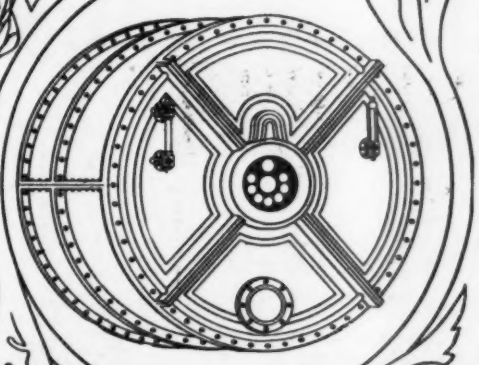

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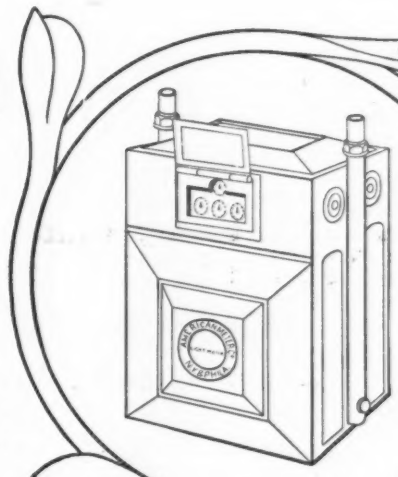
PUBLIC LIGHTING TABLE.

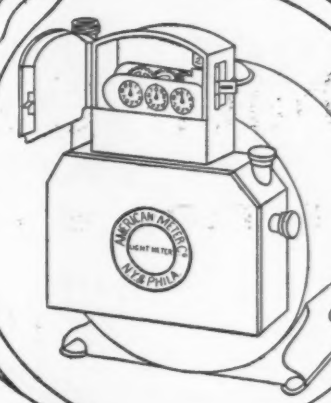
DECEMBER, 1898.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Thu.	1	5.10 PM	8.40 PM	4.20	6.10
Fri.	2	5.10	9.40	4.20	6.10
Sat.	3	5.10	10.30	4.20	6.15
Sun.	4	5.00	11.30	4.20	6.15
Mon.	5	5.00 LQ	12.30 AM	4.20	6.15
Tue.	6	5.00	1.30	4.20	6.15
Wed.	7	5.00	2.40	4.20	6.15
Thu.	8	5.00	3.40	4.20	6.15
Fri.	9	5.00	4.50	4.20	6.15
Sat.	10	5.00	6.10	4.20	6.20
Sun.	11	5.10	6.10	4.20	6.20
Mon.	12	5.10	6.10	4.20	6.20
Tue.	13	5.10 NM	6.10	4.20	6.20
Wed.	14	5.10	6.10	4.20	6.20
Thu.	15	5.10	6.10	4.30	6.20
Fri.	16	5.10	6.10	4.20	6.20
Sat.	17	5.10	6.10	4.20	6.20
Sun.	18	10.00	6.20	4.20	6.20
Mon.	19	11.10 FQ	6.20	4.20	6.20
Tue.	20	12.10 AM	6.20	4.20	6.20
Wed.	21	1.20	6.20	4.20	6.20
Thu.	22	2.20	6.20	4.20	6.20
Fri.	23	3.30	6.20	4.20	6.20
Sat.	24	4.30	6.20	4.20	6.25
Sun.	25	5.20	6.20	4.20	6.25
Mon.	26	No L.	No L.	4.20	6.25
Tue.	27	No L. FM	No L.	4.20	6.25
Wed.	28	No L.	No L.	4.20	6.25
Thu.	29	5.10 PM	7.30 PM	4.20	6.25
Fri.	30	5.10	8.30	4.20	6.25
Sat.	31	5.10	9.30	4.20	6.25

TOTAL HOURS LIGHTING DURING 1898.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	210.40	January	423.20
February	186.40	February	355.25
March	181.20	March	355.35
April	166.10	April	298.50
May	156.40	May	264.50
June	144.30	June	234.25
July	147.30	July	243.45
August	157.10	August	280.25
September	169.50	September	321.15
October	186.00	October	374.30
November	204.30	November	401.40
December	218.30	December	433.45
Total, yr.	2129.30	Total, yr.	3987.45





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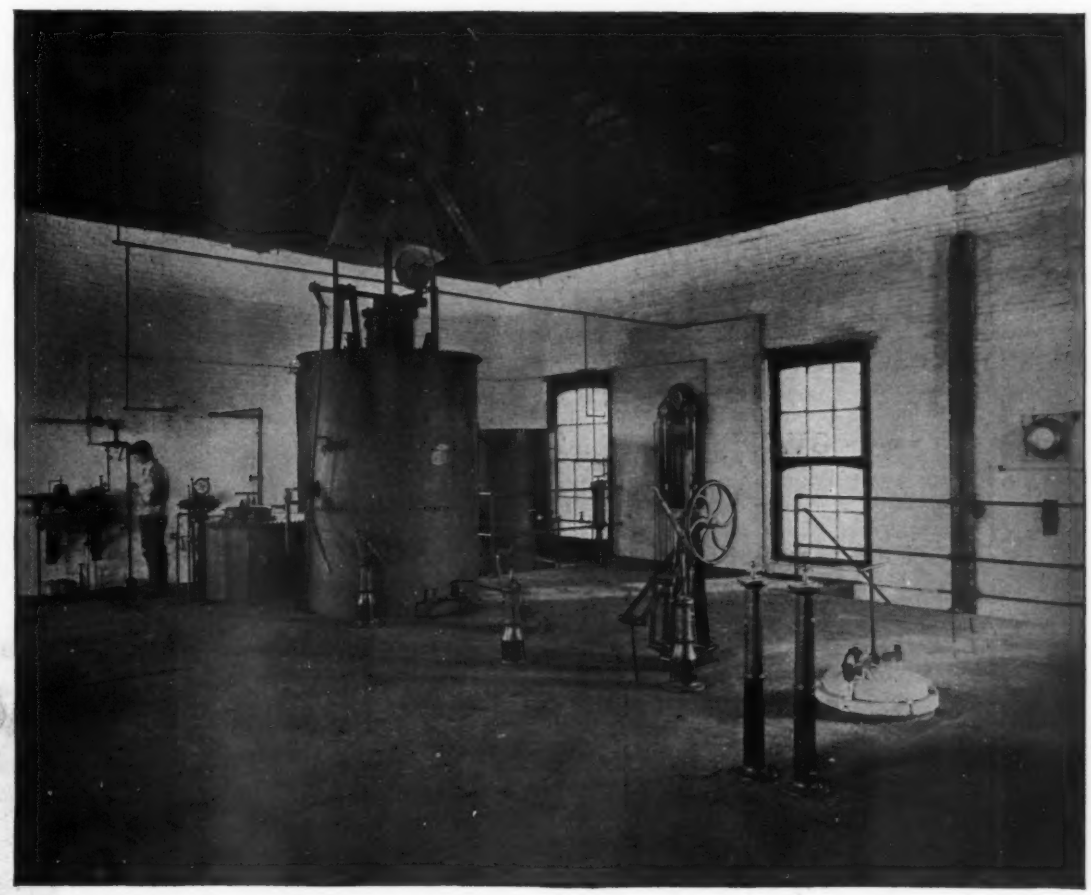

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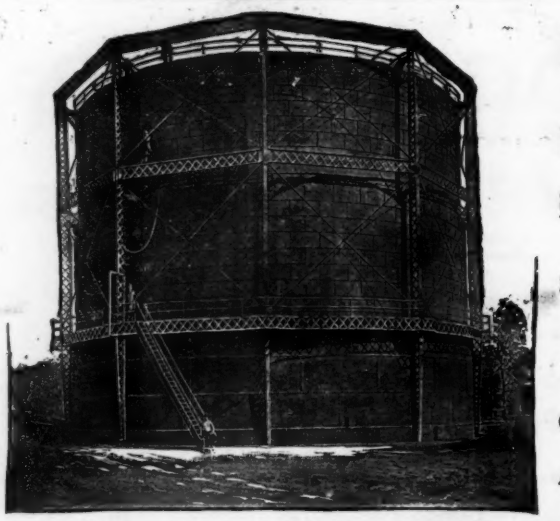

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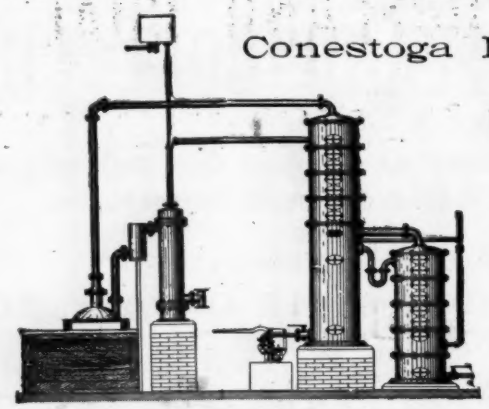

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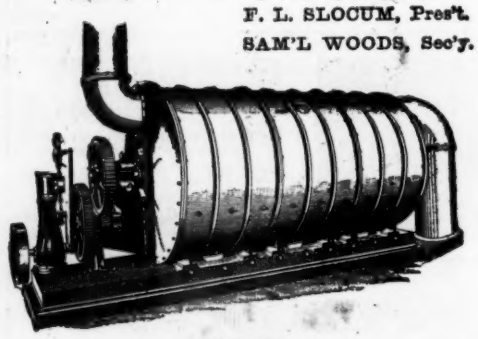

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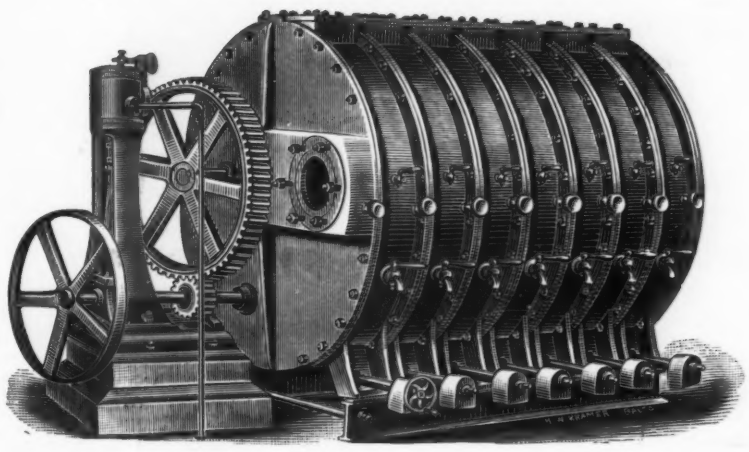

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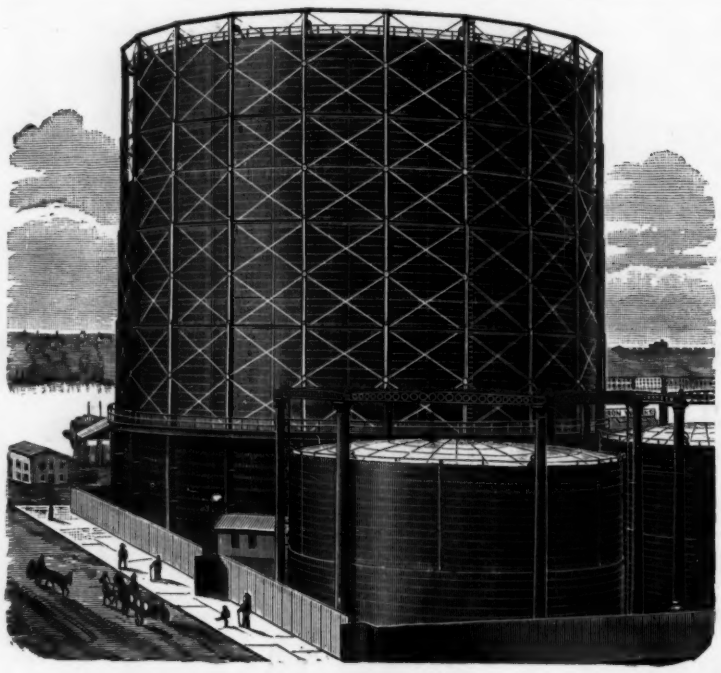

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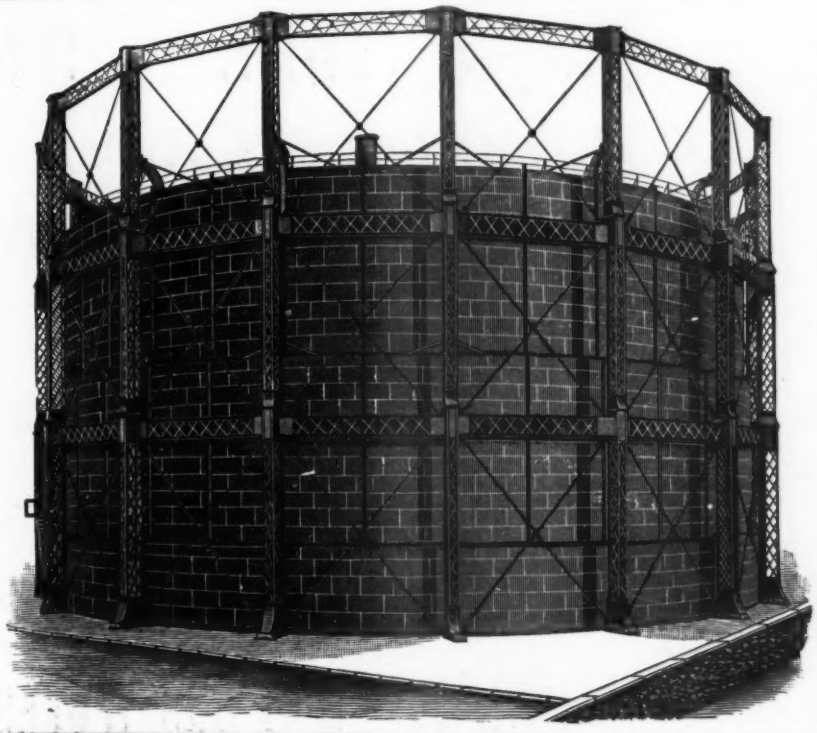

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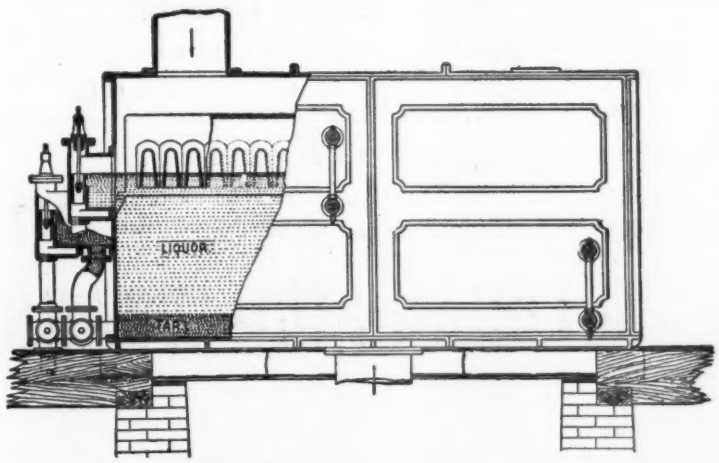

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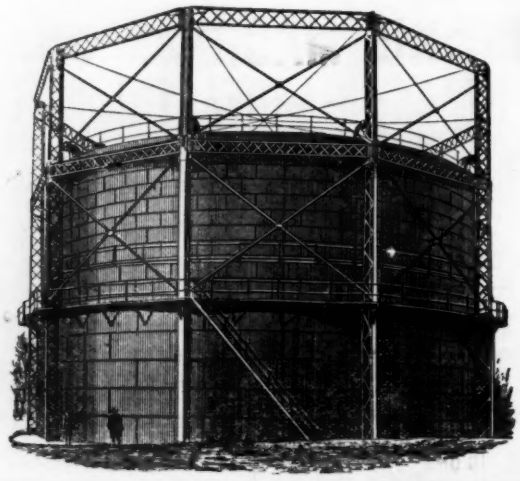

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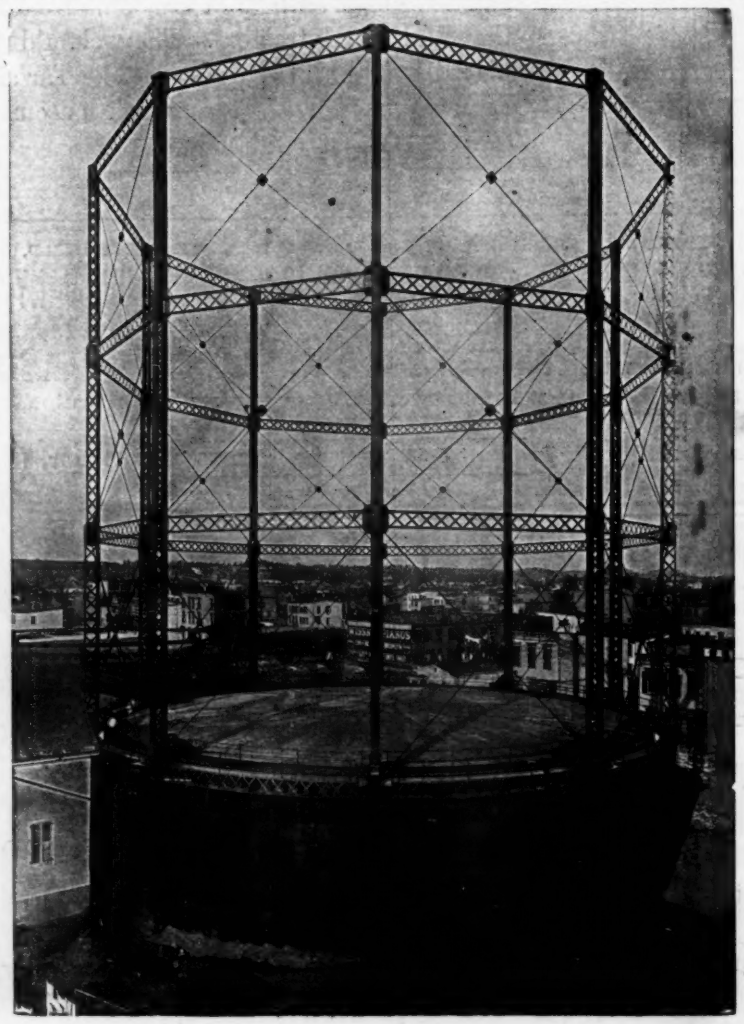

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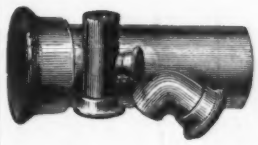

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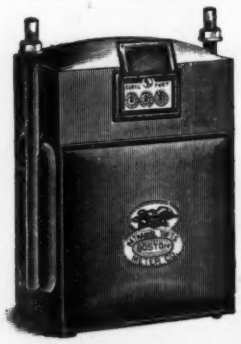

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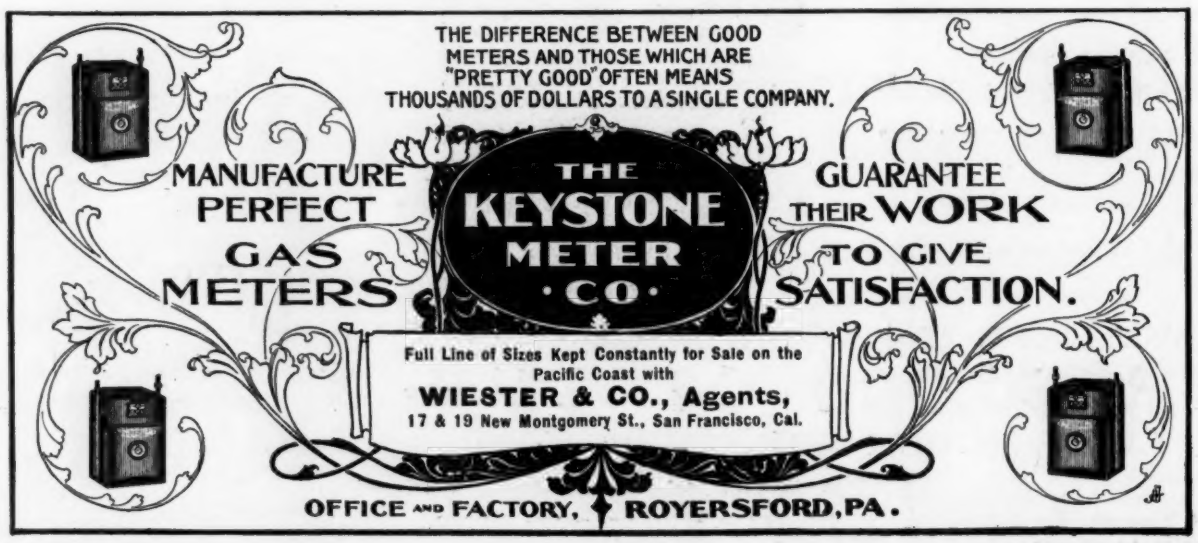
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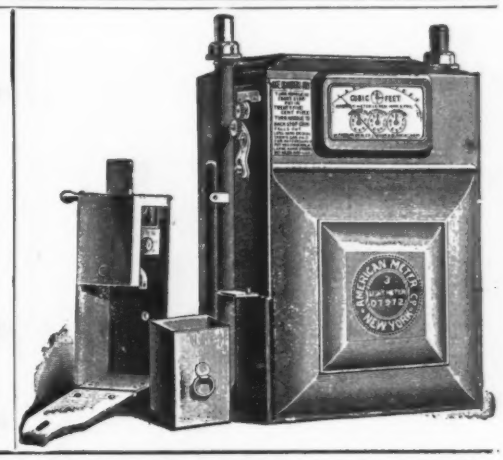

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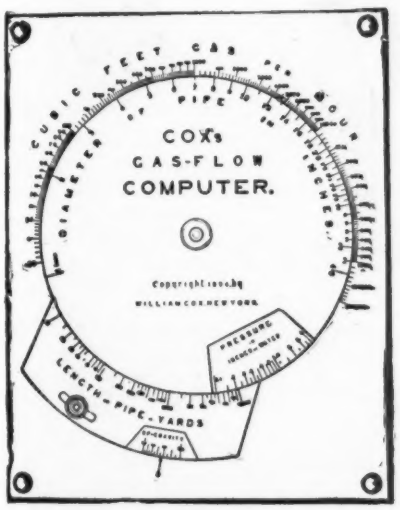

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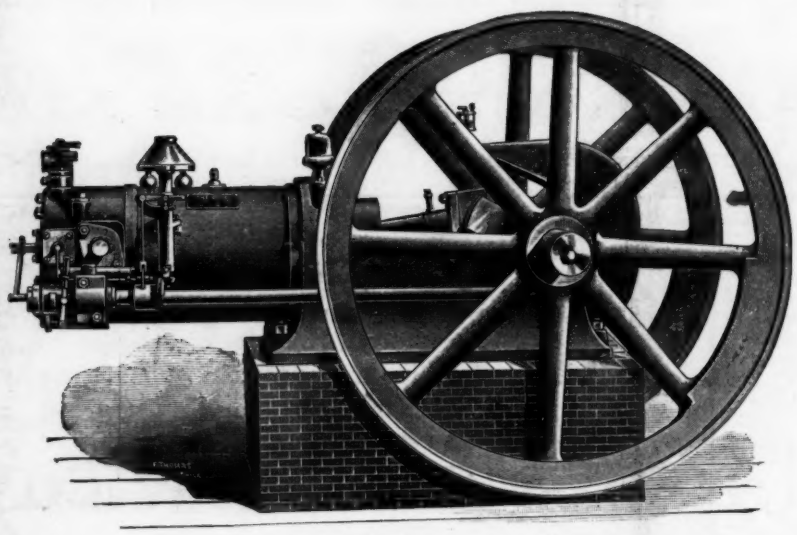

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